

FINNISH APL ASSOCIATION

FINNAPL IDIOM LIBRARY

SECOND EDITION

Jul. 13, 1982



Helsinki 1982

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FOREWORD OF FIRST EDITION

The publication of this AFL idiom collection was initiated by the FinnAFL Working Group of Programming Techniques in spring 1981, when good ways of teaching and promoting efficient use of APL were being discussed. It is a widely known fact that some idiom containing booklets and APL workspaces exist. However, the working group discovered several deficiencies in the usefulness of these sources: difficult and slow access, the relatively small amount of idioms and the lack of appropriate search methods. These arguments led to the decision of building a versatile, easy-to-use idiom library, from which any APL user can find practical tools for daily work. The goal of this publication is to promote good and efficient APL usage by means of APL idioms, and facilitate and speed up APL programming.

The first and most important source of idioms has been the Working Group itself - the experience and everybody's own idiom reservoirs. The members of the group are:

Arto Juvonen	TMT-Team
Seppo Kaltio	TMT-Team
Timo Kunnas	Helsinki University of Technology
Timo Laurmaa	Bank of Helsinki
Hannu Lehto	Datema
Heimo Penttinen	Finnish Broadcasting Company
Tauno Ylinen	Ministry of Finance

Also the following publications were very useful:

A.J. Perlis, S. Rugaber:

Programming with Idioms in APL,
APL Quote Quad, vol. 9, no. 4, 1979

K.E. Iverson:

Notation as a Tool of Thought
Communications of the ACM, vol. 23, no. 8,
August 1980

O.I. Franksen:

Computing - An Economy of Thought
NordDATA81, Copenhagen 1981

R.P. Polivka, S. Pakin:

APL: The Language and Its Usage
Prentice-Hall, 1975

R.A. Smith

A Programming Technique for Non-rectangular
Data, AFL79 Conference Proceedings, ACM.

The Finnish APL Association is pleased to receive any comments and new idioms in order to increase the versatility and quality of this idiom library.

FOREWORD OF SECOND EDITION

The second edition of the FinnAPL Idiom Library differs from the first one in several aspects: the number of idioms has been increased from 452 to 631, most of the idioms have been tested with a computer, many errors have been corrected, some explanations have been made easier to understand, and a function-based index has been included. The publication is also introduced in a more compact version (FinnAPL Pocket Idiom Library).

The working group for this edition has been:

Akif Ali	Helsinki University of Technology
Timo Kunnas	Helsinki University of Technology
Timo Laurmaa	Bank of Helsinki

FinnAPL wishes to thank for the numerous contributions by APL users from several countries, and is still pleased to receive comments and new idioms to help in developing future editions of the library.

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THE USE OF IDIOMS IN APL

Arto Juvonen
TMT-Team

1. INTRODUCTION

Idiom is a speech form that is peculiar within the usage of a given language. In APL, an idiom is a meaningful primitive structure constructed from primitive functions. Idiom is characterized by ease of recognition, frequency of occurrence and flexibility in use. Due to APL's conciseness and functional nature the language contains a large number of useful idioms, whose familiarity makes the programming effort more efficient and unravels programs made by others.

An idiom is an APL primitive construct like the APL primitive and derived functions because of its presence in the language. However, an idiom has a special connotation, that cannot be directly derived from its constituents. Once the idiom is learned, the meaning can be perceived from the program line without analyzing the structure function by function. Let us take as an example the 'if'-idiom `↑t` in a conditional branch statement. Due to the expression `→LINE↑tCOND` the program branches to line LINE, if COND (1 or 0) is true. Otherwise execution continues at the next line. The expression might be difficult to decipher, if the idiom is not familiar. After learning the behavior of the idiom the use and understanding of it is trivial.

One of the main characteristics of an idiom is its conciseness. It is easy to remember and recognize and quick to type. Because of this it is not necessary to define an idiom as a function, although this is quite common. Idioms are often more useful as part of another expression. By writing the idiom straight to the function line the naming problem can be avoided. A person acquainted with the idiom does not have to know in which workspace and with which name the expression is saved, and does not have to copy the function into the workspace. Also the problem of having a different object of the same name in the workspace can be avoided. Moreover, the reader of the program does not have to recognize the name. It is also useful to use idiomatic expressions in the library subroutines instead of the equivalent

defined functions to avoid chained calls and thus group definitions or copying of defined library functions one by one during the first application programming test run.

The difference between an idiom and a defined function can easily be seen. An important difference is their length. Idioms are almost always expressed naturally in one line. A defined function may contain more complicated, e.g. iterative structures. If an idiom is embedded in a defined function, it is useful to write it in a general form to allow wider use. Thus in a defined function the idiom is hidden in the jungle of shape and reshape functions that guarantee the compatibility of the arguments. If the idiom is written as part of the function line, the simplest form according to the current arguments can be used. There are also idioms that cannot be written as a function because of the great number of arguments or some other special feature. Such idioms are e.g. templates, that can be used to create new idioms.

2. THE USE OF IDIOMS IN WRITING AND READING PROGRAMS

No language contains a perfect set of functions for every need encountered in solving problems. APL idioms can often be used as APL primitive functions. They make the language more expressive and bring the language nearer to the human thought structures. Idioms act as an intermediate language in man-machine communication. Thus, mastering a group of basic idioms is necessary for efficient APL programming allowing the lines to be written from left to right and not a function at a time from right to left.

Idioms act also as a means of conveying thoughts between the program writer and the reader. Understanding a program is a discontinuous process. The meaning of a line is first unclear. After initial research the reader can make a hypothesis of the meaning. Additional studying verifies the model. Insight is more easily attained if the program writer and reader share a large number of idioms. Not knowing the idiom written by someone else interrupts understanding of the program flow. The reader can study the result of functions applied to sample arrays element by element, but making a hypothesis of the meaning of the expression may be very difficult.

Thus both in writing and reading programs

mastering a large set of idioms is an invaluable tool. Idioms should be learned early while learning other language fundamentals, as this helps to organize the students understanding of the numerous possibilities of the primitive functions and their combinations. Idioms are best learned by encountering them in different environments and by using them. New idioms can be found by using one-line solutions, as this helps avoiding splitting of data and thought.

3. EXAMPLES OF IDIOMS

Idioms can be classified for example in the following manner:

1. Structural
2. Sorting
3. Searching
4. Tests
5. Forming boolean vectors
6. Text processing
7. Numerical
8. Object generators
9. Subvector processing
10. Templates

Changing the structure of an array is common because of the compatibility requirements of functions. A typical example is forming a vector into a one line matrix $V \leftarrow (1, \rho V) \rho V$ or a 'column vector' $V \leftarrow (1, \rho V) \rho V$. A numeric vector can be reshaped also with the idiom $V \leftarrow V \cdot . + , 0$. Often operating with higher dimensional arrays may be cumbersome. E.g. multiplying an array A of shape k, m, n with array B of shape k, m, l, n so that the elements along the second axis of A are also used for multiplying the elements along the third axis of B necessitates forming a new axis in A after the second axis. The new axis is first shaped to contain a dimension of length one. The dimension is replicated l times by indexing:

$S \leftarrow (1, \rho A)[2 3 1 4] \rho A$ and $S \leftarrow S[;, (\rho B)[3] \rho 1;]$. An array is restructured often by the transpose function $T \& A$. The element $T[i]$ specifies, where the i :th axis of the argument array will be located in the resulting array. Thus forming a new axis after the i :th axis and replicating it n times can be generally stated with the idiom $(\# \& (I+1), 1 \& \rho A) \& (N, \rho A) \rho A$.

Sorting arrays is based on the grade primitive function $\#$. The task of idioms is to create suitable numeric arguments for the grade function.

For example a word list can be sorted with the idiom $I \leftarrow \#(pA) \sqcup Q A \sqcup M$, where A contains the alphabet used and M the words to be sorted. By using this idiom a sorting of 8 to 10 columns can be performed at a time. Sorting a wider matrix or taking other factors into consideration requires sorting to be started with the least significant sorting factor and indexing the next factor with the resulting grade vector. E.g. forming the grade vector I by using the first two columns of a numeric matrix M would be performed by using first the second column $I \leftarrow M[,2]$ and then the first one $I \leftarrow I[\#M[1,1]]$.

Often we have to sort numeric codes in vector A to the corresponding sequence S e.g. for summing. The required grade vector can be formed with the idiom $I \leftarrow \$1 A$. $A[I]$ can be used to get the lengths of the subvectors to be summed.

Searching is often based on location function () or compression of indices L/tpl. The location function can be used e.g. to locate the index of the first positive element in vector V: $(V>0) \sqcup 1$ or the index of the first occurrence of vector A in matrix M: $(M \wedge.=A) \sqcup 1$.

Test idioms are very frequent. Good examples are the test of numericity of an array A: $0 \in 0 \setminus 0 \wedge A$, and the test of emptiness: $0 \in \wedge A$, and the test of equalness of all elements in vector A: $\wedge / A = 1 \wedge A$.

Forming a modification of a logical vector is often fundamental when using the APL way of solving problems. E.g. the following transformations can be performed to a logical vector (array):

Turn on all 0's after the first 1	
L ←	0 0 1 0 1 0 1
∨\L	0 0 1 1 1 1 1
Leave on the 1's preceding the first 0	
L ←	1 1 1 0 1 0 1
∧\L	1 1 1 0 0 0 0
Leave on only the first 1	
L ←	0 0 1 0 1 1 1
∧\L	0 0 1 0 0 0 0
Create a vector of running even parity	
L ←	1 0 0 1 1 0 1
∧\L	1 1 1 0 1 1 0

Leave on the first 1 on each group of 1's
 $L \leftarrow$ 0 1 1 0 1 1 1
 $L \times 1 \downarrow 0, L$ 0 1 0 0 1 0 0
 Generally $L \times ((-\rho \rho L) \uparrow \downarrow 1) \downarrow 0, L$

Leave on the first group of 1's
 $L \leftarrow$ 0 1 1 0 1 1 0
 $L \wedge \setminus L = \setminus \setminus L$ 0 1 1 0 0 0 0

Leave on the groups of 1 in B indicated by
 the corresponding 1 in vector L
 $L \leftarrow$ 0 1 0 0 0 0 1 0 1
 $B \leftarrow$ 1 1 1 0 1 1 0 1 1
 $B \wedge A \in (L \wedge B) / A \leftarrow \setminus B \times 1 \downarrow 0, B$ 1 1 1 0 0 0 0 1 1

Text processing often aims at finding a character or a character string satisfying given conditions. Because APL primitive functions use a character as an element, the text and word processing area contains many idioms to perform higher level operations. Some examples are deletion of blanks from a character vector V: $(V \neq ' ') / V$, deleting leading blanks $(\setminus V \neq ' ') / V$ and trailing blanks: $(\setminus 1 \uparrow (V \neq ' ')) / (\rho V) / V$. Replacing each element A in vector V with B: $V[(V=A) / (\rho V)] \leftarrow B$ is simple, and the idiom $V[L / (\rho L)] \leftarrow B[(L \in I \leq \rho A) / I \in A \in V]$ can be used, if A and B are vectors. The occurrences of vector A in vector V can be located with the idiom $I \leftarrow (V[I \in \setminus 1 \uparrow (\rho A) \wedge \setminus = A]) / I \leftarrow (I = 1 \uparrow A) / (\rho I \leftarrow (1 - \rho A) \downarrow V)$. In it the possible starting locations are found by the initial letter and the length of A. The substrings of V starting from these indices are compared with A.

Vectors are often the most convenient way to handle data because of flexible selection and indexing. A vector is often divided into variable length parts (subvectors) that must be operated on analogously. In the following examples a boolean vector P indicates the partitioning of the argument vector.

$P \leftarrow 1 0 0 0 1 0 1$
 $A \leftarrow 2 3 4 5 6 7$ and $L \leftarrow 1 1 0 1 0 0 1$

The lengths of the parts
 $Z \leftarrow Z \times 1 \downarrow 0, Z \leftarrow (1 \Phi P) / (\rho P)$ 4 2 1

The sum of the elements of parts in A
 $Z \leftarrow Z \times 1 \downarrow 0, Z \leftarrow (1 \Phi P) / + \setminus A$ 10 11 7

The or-reduction of the parts in vector L
 $Z \leftarrow (P / L) \geq Z / 1 \Phi Z \leftarrow (P \vee L) / P$ 1 0 1

A template is a model that can be used to create useful structures. In the following templates α stands for a suitable function or another idiom. Template $(\rho A)\rho\alpha, A$ means raveling array A, operating on it and reshaping it back to the original shape. By using this template and a suitable idiom we can e.g. change the elements A in array S to B: $V[(V=A)/1\rho V\alpha, S]\leftarrow B$ and $S\leftarrow(\rho S)\rho V$.

Using numerical calculation instead of conditional branching is often useful. E.g. idiom $(XxB)+Yx\sim B$ can be used to select an element from X if the corresponding element in B is true, otherwise from Y. The idiom $Xx1\sim 1[B+1]$ can be used to negate the elements of X indicated by B.

The template $A\otimes B\alpha, \alpha C$ encourages to use outer product to compute all needed combinations and to select the needed ones with the diagonal transpose. For example adding the vector X to the columns of matrix M can be performed with the idiom $1\ 1\ 2\otimes X\alpha, +M$.

HOW TO USE THIS IDIOM LIBRARY

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1. THE PARTS OF THE IDIOM LIBRARY

1.1 Idiom List

The library is based on an idiom list containing 631 APL idioms. Every idiom consists of an APL expression, a brief verbal description, the description of arguments and parameters, and an index number. The list is sorted in a 'functionally alphabetical' order; therefore two very similar idioms will not be far from each other. The functionally alphabetical order is based on the order of functions listed in the Table of Functions so that e.g. expressions containing Φ are found in the beginning of the list and so on.

The argument description states the requirements set to the variables in the expression (arguments or parameters). The most common requirements include information of the rank or shape of the array as well as the type, according to the following rules:

- Naming convention of data objects:
 - X,Y arguments
 - G,H parameters
 - A,B intermediate results etc.
- Data type expressions (in argument descriptions):
 - C = character
 - B = logical (boolean)
 - I = integer
 - D = any numeric data type
 - A = any data type, no limitations
- Representation of the ranks of arrays:
 - 0 = scalar
 - 1 = vector
 - 2 = matrix
 - = (empty) no limitations; the shape is mentioned separately, if necessary
- Examples
 - X←D2 argument X is a numeric matrix
 - G←I0 parameter G is an integer scalar

1.2 Permutated index

The bulk of this idiom library consists of an alphabetical index sorted according to a so-called permuted index (keyword in context) method. This method is used in order to facilitate finding appropriate idioms with the assistance of typical keywords. A verbal description with n words will usually occur in n places in the index, at the place of each word of the description. This provides an easy way to find a suitable idiom even if its description is not completely known. The index contains a reference to the index numbers in the idiom list. If a description corresponds to two idioms with numbers clearly unequal, it is likely that the desired result can be achieved with two highly different solutions (nearly equal numbers would indicate similarly built expressions).

1.3 Synonym list

Same results can be achieved in several different ways in APL. This list is a collection of certain idioms from the idiom list that perform (at least approximately) similar operations. (They may differ from each other for instance by requirements set for their arguments.) The synonym list gives a good insight of how to produce similar results in many different ways in APL. Studying these differences will certainly help widening the understanding of APL idioms and expressions.

2. LIMITATIONS OF THE IDIOM LIBRARY

APL idiom library has been designed for the most common programming circumstances. Consequently, some idioms will not work as desired in every special situations. The idioms will generally work with at least the default values of a VS APL empty workspace, which usually apply also in application workspaces. Possible circumstances for unexpected behaviour of certain idioms might be for instance

- $\text{OPP} \leftarrow 4$ Printing precision is small
- $\text{OCT} \leftarrow 0.1$ Comparison tolerance is high

The index origin DIO deserves special consideration. As the default value is one, every idiom (unless the description states differently) will work if $\text{DIO} = 1$. Several idioms include DIO in the APL expression, which means that the idiom works with both possible DIO values. Exception

cases (works only if DIO = 0) are reported separately in the verbal description. The great majority of the idioms will work in the expected way, independent of parameter values.

This publication intends to present only efficient idioms that promote good APL programming style. It is, however, sometimes difficult to decide if an APL expression will be efficient in every situation. Therefore, especially in handling very large data objects there is a danger that huge amounts of cpu time will be spent or that a WS FULL occurs unexpectedly. If the idiom is good in principle ($(X\backslash X)=1\backslash X$ is a typical example), but in some conditions may turn out to be inefficient, this is mentioned in the verbal description. Avoiding WS FULL problem is possible for instance with the thumb rule stating that the outer product \times may easily cause a WS FULL if large data objects are being handled.

Some idioms include numeric or character constants which make the idioms more recognizable but seem to reduce their generality. For instance, the idiom DIVIDING A 400x12 CHARACTER MATRIX INTO ONE PAGE contains the constants 400 and 12, which clearly have to be modified according to the column width and page length.

Certain idioms contain the delta function Δ needed when chaining expressions. If these idioms are used, the workspace should contain this function defined in the following way:

```
    ∇Z←A Δ B
[1]   Z←A
    ∇
```

This function causes the rightmost expression to be processed first. The leftmost expression will then be executed independently of the result of the previous one.

3. EXAMPLES OF THE USE OF THE IDIOM LIBRARY

3.1 Finding an idiom to perform a desired task

If we want to use the idiom library to find an expression that underlines a text vector, we can examine words UNDERLINE, TEXT and VECTOR in the index. If the desired idiom belongs to the library, some of these key words will very likely be found in the index. As related idioms are described as UNDERLINING A STRING and UNDERLINING

WORD, - key word UNDERLINING will show where a suitable idiom can be found.

3.2 How can decode T be used

Because the idiom list is sorted according to a functional order, most idioms using T are grouped in the same part of the list, near its beginning. Studying idioms in this way will help learning new ways of applying APL functions and thus widen the APL way of thinking.

3.3 Removing duplicate lines or elements

The index part contains several idioms under the keyword DUPLICATE. These idioms have been collected to the synonym list. By comparing these idioms it is possible to find an expression that will work properly and efficiently in the desired situation, like finding different words from a word matrix.

3.4 What does expression $A \circ. +, 0$ do

Idioms based on the outer product can easily be found in the idiom list. The verbal description of idiom $X \circ. +, 0$ shows that this is a way to form a one-column matrix from a vector.

TABLE OF FUNCTIONS

1 ... 37	GRADE UP Δ
38 ... 44	GRADE DOWN ∇
45 ... 63	ENCODE τ
64 ... 84	DECODE ι
85 ... 101	EXECUTE \pm
102 ... 111	FORMAT Φ
112 ... 120	BRANCH \rightarrow
121 ... 123	ROLL / DEAL ?
124 ... 128	MATRIX INVERSION / MATRIX DIVISION \boxdot
129 ... 134	GEOMETRICAL \circ
135 ... 142	FACTORIAL / BINOMIAL :
143 ... 204	OUTER PRODUCT $\circ\omega$
205 ... 246	INNER PRODUCT $\alpha\omega$
247 ... 310	SCAN $\omega\backslash\omega\wedge$
311 ... 374	REDUCTION $\omega/\omega\ddagger$
375 ... 412	TAKE \uparrow
413 ... 448	DROP \downarrow
449 ... 449	CEILING / MAXIMUM Γ
450 ... 462	FLOOR / MINIMUM Λ
463 ... 479	MAGNITUDE / RESIDUE \mid
480 ... 490	EXPAND \
491 ... 513	COMPRESS /
514 ... 527	TRANSPOSE Φ
528 ... 537	REVERSE / ROTATE $\Phi\Theta$
538 ... 548	MEMBER OF ϵ
549 ... 563	INDEX GENERATOR / INDEX OF ι
564 ... 569	LOGICAL $\sim\vee\wedge\vee\wedge\wedge$
570 ... 575	COMPARISON $<\leq=\geq>\neq$
576 ... 598	RAVEL / CATENATE ,
599 ... 609	AXIS / INDEXING [
610 ... 618	SHAPE / RESHAPE ρ
619 ... 628	ARITHMETIC $+-\times\div$
629 ... 631	MISCELLANEOUS

IDIOM LIST

GRADE UP Δ

1 $L.5 \times (\Delta\Delta X) + \Phi\Delta\Delta\Phi X$ $X \leftarrow D1$
Ascending cardinal numbers (ranking, shareable)

2 $Y[A_i \sqcap \Delta A[\Delta(+\backslash X)[A \leftarrow \Delta Y]]]$ $X \leftarrow B1; Y \leftarrow D1$
Maximum scan (\sqcap) over subvectors of Y indicated by X

3 $Y[A_i \sqcup \Delta A[\Delta(+\backslash X)[A \leftarrow \Psi Y]]]$ $X \leftarrow B1; Y \leftarrow D1$
Minimum scan (\sqcup) over subvectors of Y indicated by X

4 $Y[\Delta Y] \wedge . = X[\Delta X]$ $X \leftarrow D1; Y \leftarrow D1$
Test if X and Y are permutations of each other

5 $X[A[\Delta(+\backslash(\iota\rho X)\epsilon + \square IO, Y)[A \leftarrow \Delta X]]]$ $X \leftarrow D1; Y \leftarrow I1; (\rho X) \leftrightarrow +/Y$
Sorting subvectors of lengths Y

6 $Y[A[X/\Delta(+\backslash X)[A \leftarrow \Delta Y]]]$ $X \leftarrow B1; Y \leftarrow D1$
Minima (\sqcap) of elements of subvectors of Y indicated by X

7 $A[\Delta(+\backslash X)[A \leftarrow \Delta Y]]$ $X \leftarrow B1; Y \leftarrow D1$
Grading up subvectors of Y indicated by X

8 $(\rho X)\rho(, X)[\square IO + A[\Delta[A \div^{-1} \uparrow \rho X]] \Delta A \leftarrow (\Delta, X) - \square IO$ $X \leftarrow D2$
Sorting rows of matrix X into ascending order

9 $(\rho X)\rho(, X)[A[\Delta(, \Phi(\Phi\rho X)\rho(1 \uparrow \rho X)[A \leftarrow \Delta, X]]]$ $X \leftarrow D2$
Sorting rows of matrix X into ascending order

10 $(\Delta\Delta(G+1), \iota\rho\rho X)\Phi(Y, \rho X)\rho X$ $G \leftarrow I0; Y \leftarrow I0; X \leftarrow A$
Adding a new dimension after dimension G Y-fold

11 $(Y, X, Z, \dots)[\Delta\Delta G]$ $X \leftarrow A1; Y \leftarrow A1; Z \leftarrow A1; \dots; G \leftarrow I1$
Merging X, Y, Z ... under control of G (mesh)

12 $(X, Y)[\Delta\Delta G]$ $X \leftarrow A1; Y \leftarrow A1; G \leftarrow B1$
Merging X and Y under control of G (mesh)

13 $\Delta\Delta X$ $X \leftarrow D1$
Ascending cardinal numbers (ranking, all different)

14 $Y[A[X/\Delta(+\backslash X)[A \leftarrow \Psi Y]]]$ $X \leftarrow B1; Y \leftarrow D1$
Maxima (\sqcup) of elements of subvectors of Y indicated by X

15 $A[\Delta(+\backslash X)[A \leftarrow \Psi Y]]$ $X \leftarrow B1; Y \leftarrow D1$
Grading down subvectors of Y indicated by X

16 $(Y, X)[\Delta\Psi G]$ $X \leftarrow A1; Y \leftarrow A1; G \leftarrow B1$
Merging X and Y under control of G (mesh)

17 $\Delta\Psi X$ $X \leftarrow D1$
Descending cardinal numbers (ranking, all different)

18 $X[\Delta(1+\rho Y) \leq Y \leq X]$ $X \leftarrow A2; Y \leftarrow A1$
Sorting rows of X according to key Y (alphabetizing)

19 $X[\Delta + f A < . - \Delta A \leftarrow X, 0;]$ $X \leftarrow D2$
Sorting a matrix into lexicographic order

20 $X[\Delta X]^. = \rho X$ $X \leftarrow I1$
Test if X is a permutation vector

21 $Y[\Delta X++ \setminus X]$ $X \leftarrow B1; Y \leftarrow A1$
Rotate first elements (1Φ) of subvectors of Y indicated by X

22 $1 \uparrow \Delta X$ $X \leftarrow D1$
Index of (first) minimum element of X

23 $-1 \uparrow \Delta X$ $X \leftarrow D1$
Index of (first) maximum element of X

24 $X[(\Delta X)[\lceil .5 \times \rho X \rceil]]$ $X \leftarrow D1$
Median

25 $(X, '')'[(\square I0 + \rho X) \mid \Delta(\rho X), ('' = X) / \rho X]$ $X \leftarrow C1$
Doubling quotes (for execution)

26 $(X, '*')[(\square I0 + \rho X) \mid \Delta(\rho X), (Y \times \rho G) \rho G]$ $X \leftarrow C1; Y \leftarrow I0; G \leftarrow I1$
*Inserting Y *'s into vector X after indices G*

27 $(\rho X) \geq \Delta(\rho X), Y$ $X \leftarrow D1; Y \leftarrow I1$
Expansion vector with zero after indices Y

28 $(X, A \rho H)[\Delta(\rho X), A \rho Y] \Delta A \leftarrow G \times \rho, Y$ $X \leftarrow A1; Y \leftarrow I1; G \leftarrow I0; H \leftarrow A0$
Catenating G elements H after indices Y in vector X

29 $((A \rho H), X)[\Delta(A \rho Y), \rho X] \Delta A \leftarrow G \times \rho, Y$ $X \leftarrow A1; Y \leftarrow I1; G \leftarrow I0; H \leftarrow A0$
Catenating G elements H before indices Y in vector X

30 $\Delta Y \leq X$ $Y \leftarrow A1; X \leftarrow A1$
Grade up according to key Y

31 $A \Delta A[\Delta G] \leftarrow A \leftarrow Y, X$ $X \leftarrow A1; Y \leftarrow A1; G \leftarrow B1$
Merging X and Y under control of G (mesh)

32 $X[\Delta Y[X]]$ $X \leftarrow I1; Y \leftarrow D1$
Sorting indices X according to data Y

33 $X[\Delta X[;Y];]$ $X \leftarrow D2$
Sorting a matrix according to Y:th column

34 $\Delta X \times -1 \ 1[Y]$ $X \leftarrow D1; Y \leftarrow I0$
Choosing sorting direction during execution

35 $X[\Delta X]$ $X \leftarrow D1$
Sorting X into ascending order

36 $Y[\Delta X]$ $X \leftarrow A1; Y \leftarrow A1$
Sorting Y according to X

37 ΔX $X \leftarrow I1$
Inverting a permutation

GRADE DOWN Ψ

38 $X[\Psi + \{A < -Q\} \leftarrow X, 0;]$ $X \leftarrow D2$
Sorting a matrix into reverse lexicographic order

39 $X[\Phi\Psi + \{(\rho X) \in + \square IO, Y\}]$ $X \leftarrow D1; Y \leftarrow I1$
Reversal (Φ) of subvectors having lengths Y

40 $Y[\Phi\Psi + \{X\}]$ $X \leftarrow B1; Y \leftarrow A1$
Reversal (Φ) of subvectors starting at indices X

41 $(+/X) \uparrow \Psi X$ $X \leftarrow B1$
Indices of ones in logical vector X

42 $X[\Psi' ' \# X]$ $X \leftarrow C1$
Moving all blanks to end of text

43 $X[\Psi Y]$ $X \leftarrow A1; Y \leftarrow B1$
Moving elements satisfying condition Y to the start of X

44 $X[\Psi X]$ $X \leftarrow D1$
Sorting X into descending order

ENCODE τ

45 $\Psi 10((1+\lceil 2 \otimes \lceil /, X) \rho 2) \tau X$ $X \leftarrow I0$
Binary format of decimal number X

46 $1 0 \Psi 10 10 \tau 1 - \square IO - \lceil X$ $X \leftarrow I0$
Helps locating column positions 1..X

47 $\Phi((0, \lceil \rho X) \circ . = + \lceil \sim A) + . \times (-X) \times . * A \leftarrow ((\rho X) \rho 2) \tau^{-1} + \lceil 2 * \rho X$ $X \leftarrow D1$
Polynomial with roots X

48 $\square IO + (\rho X) \tau - \square IO - (, (X = (\rho X) \rho \lceil \# X) \wedge X = \Psi((\Phi \rho X) \rho 1 / X) / \lceil \times / \rho X$ $X \leftarrow D2$
Index pairs of saddle points

49 $\Psi '0123456789ABCDEF' [\square IO + ((\lceil \lceil / 16 \otimes, X) \rho 16) \tau X]$ $X \leftarrow I$
Conversion from decimal to hexadecimal

50 $(, X) / 1 + A \tau^{-1} + \lceil \times / A \leftarrow \rho X$ $X \leftarrow C2$
Transforming connectivity matrix X into a connectivity list

51 $\square IO + (\rho X) \tau (\lceil \times / \rho X) - \square IO$ $X \leftarrow A$
Matrix of all indices of X

52 $((\lceil 2@1+X\rceil\rho2)\tau0,1X$ $X\leftarrow I0$
All binary representations up to X (truth table)

53 $((1+\lfloor 10@X\rceil\rho10)\tau X$ $X\leftarrow I0$
Digits of X separately

54 $((1+\lfloor Y@X\rceil\rho Y)\tau X$ $X\leftarrow D0; Y\leftarrow D0$
Representation of X in base Y

55 $\lceil I0+(\rho X)\tau(-\lceil I0\rceil+(,X\in Y)/\lceil\rho,X$ $X\leftarrow A; Y\leftarrow A$
Indices of elements Y in array X

56 $,',\&'0123456789ABCDEF'[\lceil I0+16 16\tau-\lceil I0-\lceil A\tau iX]$ $X\leftarrow C1$
Conversion of characters to hexadecimal representation (\lceil A\tau)

57 $\&(3\rho100)\tau X$ $X\leftarrow D$
Separating a date YYMMDD to YY, MM, DD

58 $\lceil I0+(X,Y)\tau(1X\times Y)-\lceil I0$ $X\leftarrow I0; Y\leftarrow I0$
All pairs of elements of 1X and 1Y

59 $((\rho X)\rho2)\tau^{-1+12*\rho X}$ $X\leftarrow A1$
Matrix for choosing all subsets of X (truth table)

60 $(X\rho2)\tau^{-1+12*X}$ $X\leftarrow I0$
All binary representations with X bits (truth table)

61 $1+Y\tau X$ $X\leftarrow D; Y\leftarrow D0$
Incrementing cyclic counter X with upper limit Y

62 $0 1\tau X$ $X\leftarrow D$
Integer and fractional parts of positive numbers

63 $10 100 1000\tau X$ $X\leftarrow I$
Decoding numeric code ABBCCC into a matrix

64 $A \Delta A[3 6]\leftarrow':' \Delta A\leftarrow\$1000\lceil3\uparrow3\downarrow\lceil TS$
Representation of current time (24 hour clock)

65 $A \Delta A[5 8]\leftarrow'-' \Delta A\leftarrow\$1000\lceil3\uparrow\lceil TS$
Representation of current date (descending format)

66 $\rightarrow Y[1+2\lceil X]$ $Y\leftarrow I1; X\leftarrow B1$
Case structure with an encoded branch destination

67 $G\lceil Y\lceil X\circ.\ast\Phi-\lceil I0-\lceil\rho X$ $X\leftarrow D1; Y\leftarrow D1; G\leftarrow D0$
Interpolated value of series (X,Y) at G

68 $' *o@'[\lceil I0+2\lceil X\circ.\ge\lceil /,X]$ $X\leftarrow I2; 1\rho\rho X \leftrightarrow 2$
Barchart of two integer series (across the page)

69 $(X \cdot ., 0) \downarrow Y$ $X \leftarrow D1; Y \leftarrow D1$
Value of polynomial with coefficients Y at points X

70 $((A \downarrow A) = \downarrow \rho A \leftarrow 2 \downarrow X \wedge . = \Phi X) \uparrow X$ $X \leftarrow A2$
Removing duplicate rows

71 $B \rho A \Delta A[\Box I0 + B[1] \downarrow - \Box I0 - X] \leftarrow 1 \Delta A \leftarrow (x / B \leftarrow 0 \ 0 + [/, X] \rho 0$ $X \leftarrow C2$
Transforming connectivity list X into a connectivity matrix

72 $100 \downarrow 100 \downarrow 3 \uparrow \Box TS$
Encoding current date

73 $(1 - (' ' = X) \downarrow 1) \downarrow X$ $X \leftarrow C1$
Removing trailing blanks

74 $(12 \rho 7 \rho 31 \ 30)[X] - 0 \downarrow - 1 + 2 \downarrow (X = 2), [.1] 0 \neq 4 \downarrow Y$ $X \leftarrow I0; Y \leftarrow I$
Number of days in month X of year Y

75 $16 \downarrow - \Box I0 - '0123456789ABCDEF' \downarrow \Phi X$ $X \leftarrow C$
Conversion from hexadecimal to decimal

76 $(1 - (' ' = X) \downarrow 1) \Phi X$ $X \leftarrow C$
Justifying right

77 $(\div 1 + Y \div 100) \downarrow \Phi X$ $X \leftarrow D1; Y \leftarrow D0$
Present value of cash flows X at interest rate Y %

78 $10 \downarrow - 1 + '0123456789' \downarrow X$ $X \leftarrow C1$
Transformation of alphanumeric string into numeric

79 $(' ' = X) \downarrow 1$ $X \leftarrow C1$
Index of first non-blank, counted from the rear

80 $(, X)[\Box I0 + (\rho X) \downarrow Y - \Box I0]$ $X \leftarrow A; Y \leftarrow I2$
Indexing scattered elements

81 $\Box I0 + (\rho X) \downarrow Y - \Box I0$ $X \leftarrow A; Y \leftarrow I2$
Conversion of indices to indices of raveled array

82 $(1 + Y \div 100) \downarrow X$ $X \leftarrow D1; Y \leftarrow D0$
Future value of cash flows X at interest rate Y %

83 $X \downarrow Y$ $X \leftarrow D0; Y \leftarrow D$
Value of polynomial with coefficients Y at point X

84 $2 \downarrow X$ $X \leftarrow B$
Integer representation of logical vectors

85 $\pm '1', '1 \downarrow'[\Box I0 + \wedge / (\rho X) = \Phi \rho X], '''0 \sim 0 \epsilon X = - \Phi X'''$ $X \leftarrow D2$
Test for antisymmetry of matrix X

86 $\$\$'1', '1\downarrow'[\Box I0+\wedge/(\rho X)=\Phi\rho X], '''0\sim0\in X=\Phi X'''$ $X\leftarrow A2$
Test for symmetricity of matrix X

87 $\Box I0\otimes(\pm'.'\# A)/A\leftarrow \mp X)\div X$ $X\leftarrow D1$
Number of decimals of elements of X

88 $\$'VAR', (\mp X), ' \leftarrow Y'$ $X\leftarrow A0; Y\leftarrow A$
Using a variable named according to X

89 $\$X/\wedge'$ $X\leftarrow L0$
Conditional branch out of programs

90 $' *'[\Box I0+(\Phi(-1+L/A)+\wedge 1+(\lceil /A)-\lfloor /A)\wedge .=A\leftarrow L.5+\pm F]$ $F\leftarrow A1; X\leftarrow D1$
Graph of F(X) at points X ('X'\in F)

91 $A+\cdot\wedge\pm F, 0\rho X\leftarrow Y[1]+(A\leftarrow--/Y\div G)\times 0, \wedge G$ $F\leftarrow A1; G\leftarrow D0; Y\leftarrow D1; \rho Y \leftrightarrow 2$
Definite integral of F(X) in range Y with G steps ('X'\in F)

92 $X\leftarrow \pm, ((2\uparrow'X'), ' ', [.5]A)[\Box I0+\wedge' ' \wedge .=A\leftarrow, \Box;]$ $X\leftarrow D1$
Changing X if a new input value is given

93 $(Xv.\#' ')\backslash 1\downarrow\pm'0 ',, X, ' '$ $X\leftarrow C2$
Conversion of each row into a number (default zero)

94 $\$((X\wedge.= ' ')/'Y'), X$ $X\leftarrow D1$
Converting expression X to numeric form with default value Y

95 $1\downarrow\pm'0 ', (\wedge/X\in' 0123456789')/X$ $X\leftarrow C1$
Test if numeric and converting into numeric form

96 $\$X/\wedge'EXPRESSION'$ $X\leftarrow B0$
Conditional execution

97 $1\rho(\pm\Box, ' , \wedge 0'), X$ $X\leftarrow D0$
Giving a numeric default value for input

98 $A\leftarrow \pm, ' , ' , ' (', ' 0', ' \rho', Y, ' \leftarrow', X, ')'$ $X\leftarrow C2; Y\leftarrow C2$
Assign values of expressions in X to variables named in Y

99 $\$, ' , ' , ' (', ' , ' , X, ')'$ $X\leftarrow A$
Evaluation of several expressions; results form a vector

100 $\$'X[', ((-1+\rho\rho X)\rho';'), 'Y']'$ $X\leftarrow A; Y\leftarrow I$
Indexing when rank is not known beforehand

101 $\$, '+', X$ $X\leftarrow A2$
Sum of numbers in character matrix X

FORMAT \mp

102 $(3\Phi7 0\mp X\cdot\cdot\cdot, 0), \mp Y$ $X\leftarrow D1; Y\leftarrow A2$
Numeric headers (elements of X) for rows of table Y

103 $\$X \cdot . + , 0$ $X \leftarrow D1$
Formatting a numerical vector to run down the page

104 $A \Delta A[(\cdot \cdot = A) / \cdot \cdot \rho A] \leftarrow \cdot \cdot \Delta A \leftarrow \$\Phi 3 \uparrow \square TS$ $\Delta A \leftarrow \$\Phi 3 \uparrow \square TS$
Representation of current date (ascending format)

105 $(, (0 \downarrow 3 0 \# 100 + 3 \downarrow 1 \rho 12 0 0 \mid 3 \uparrow 3 \downarrow \square TS), ' :: '), ' AP' [1 + 12 \leq \square TS[4]], ' M'$ $X \leftarrow I1; Y \leftarrow I0$
Representation of current time (12 hour clock)

106 $0 \downarrow 1 \downarrow (2 \uparrow Y + 1) \# (10 * Y) + ((\rho X), 1) \rho X$ $X \leftarrow I1; Y \leftarrow I0$
Leading zeroes for positive numbers X in fields of width Y

107 $A \Delta A[(\cdot \cdot = A) / \cdot \cdot \rho A] \leftarrow / / \Delta A \leftarrow \$100 \mid 1 \Phi 3 \uparrow \square TS$ $\Delta A \leftarrow \$100 \mid 1 \Phi 3 \uparrow \square TS$
Representation of current date (American)

108 $(\rho A) \rho B \setminus (B \leftarrow, (' 0 ' \# A) \vee ' \# - 1 \Phi A) / , A \leftarrow ' ' , \X $X \leftarrow A$
Formatting with zero values replaced by blanks

109 $((1, G) \times \rho X) \rho 2 \mid 3 \Phi (\Phi G, \rho X) \rho (, G, [1.1] Y) \# X$ $X \leftarrow D2; Y \leftarrow I1; G \leftarrow I0$
Row-by-row formatting (width G) of X with Y decimals per row

110 $(, G, [1.1] H) \# X$ $X \leftarrow D; G \leftarrow I1; H \leftarrow I1$
Formatting X with H decimals in fields of width G

111 $\rho \$X$ $X \leftarrow D0$
Number of digit positions in scalar X (depends on $\square PP$)

BRANCH →

112 $\rightarrow \square LC \lceil \downarrow \vee / , (X \leftarrow X \vee X \vee . \wedge X) \# + X$ $X \leftarrow B2$
Forming a transitive closure

113 $\rightarrow Y \lceil \downarrow G \geq X \leftarrow X + 1$ $X \leftarrow I0; Y \leftarrow I0; G \leftarrow I0$
For-loop ending construct

114 $\rightarrow Y \lceil \downarrow X$ $X \leftarrow B0; Y \leftarrow I0$
Conditional branch to line Y

115 $\rightarrow X / Y$ $X \leftarrow B1; Y \leftarrow I1$
Case structure with logical switch (preferring from start)

116 $\rightarrow X \Phi Y$ $X \leftarrow I0; Y \leftarrow I1$
Case structure with integer switch

117 $\rightarrow Y [G \lceil X]$ $X \leftarrow A0; Y \leftarrow I1; G \leftarrow A1$
Case structure according to key vector G

118 $\rightarrow 0 \times \downarrow X$ $X \leftarrow B0$
Conditional branch out of program

119 $\rightarrow Y [2 + \times X]$ $X \leftarrow I0; Y \leftarrow I1$
Conditional branch depending on sign of X

120 $\rightarrow Y \times X$ $X \leftarrow D0; Y \leftarrow I0$
Continuing from line Y (if $X > 0$) or exit

ROLL / DEAL ?

121 $X[1]+?Y \rho --/X$ $X \leftarrow I1; Y \leftarrow I1$
Y-shaped array of random numbers within ($X[1], X[2]$)

122 $?Y \rho X$ $Y \leftarrow I; X \leftarrow I$
Choosing Y objects out of ιX with replacement (roll)

123 $Y?X$ $X \leftarrow I0; Y \leftarrow I0$
Choosing Y objects out of ιX without replacement (deal)

MATRIX INVERSION / MATRIX DIVISION \boxplus

124 $*A+.x(\oplus Y) \boxtimes A \leftarrow X \cdot \cdot \cdot 0 1$ $X \leftarrow D1; Y \leftarrow D1$
Predicted values of exponential (curve) fit

125 $A \cdot \cdot \cdot Y \boxtimes A \leftarrow X \cdot \cdot \cdot 0 1$ $X \leftarrow D1; Y \leftarrow D1$
Predicted values of best linear fit (least squares)

126 $\Phi Y \boxtimes X \cdot \cdot \cdot 0, \iota G$ $X \leftarrow D1; Y \leftarrow D1$
G-degree polynomial (curve) fit of points (X,Y)

127 $A \Delta A[1] \leftarrow *A[1] \Delta A \leftarrow (\oplus Y) \boxtimes X \cdot \cdot \cdot 0 1$ $X \leftarrow D1; Y \leftarrow D1$
Coefficients of exponential (curve) fit of points (X,Y)

128 $Y \boxtimes X \cdot \cdot \cdot 0 1$ $X \leftarrow D1; Y \leftarrow D1$
Best linear fit of points (X,Y) (least squares)

GEOMETRICAL \circ

129 $((X \neq 0) \times -3 \circ Y \div X + X = 0) + 0 ((X = 0) \times .5 \times \times Y) + (X < 0) \times 1 - 2 \times Y < 0$ $X \leftarrow D; Y \leftarrow D$
Arctan $Y \div X$

130 $1 2 \times .0 X, Y$ $X \leftarrow D0, Y \leftarrow D0$
A way to combine trigonometric functions (sin X cos Y)

131 $\circ / -2 1, X$ $X \leftarrow D0$
Complementary angle (arccos sin X)

132 $2 2 \rho 1 -1 1 1 \times 2 1 1 2 \times X$ $X \leftarrow D0$
Rotation matrix for angle X (in radians) counter-clockwise

133 $X \times 180 \div 01$ $X \leftarrow D$
Transformation from radians to degrees

134 $X \times 0 \div 180$ $X \leftarrow D$
Transformation from degrees to radians

FACTORIAL / BINOMIAL :

135 $(!Y) \times Y! X$ $X \leftarrow D; Y \leftarrow D$
Number of permutations of X objects taken Y at a time

136 $\Phi A \dots A \leftarrow 0, i X$ $X \leftarrow I0$
Pascal's triangle of order X (binomial coefficients)

137 $+ / Y \times (X * A) \div !A \leftarrow -1 + i p Y$ $X \leftarrow D0; Y \leftarrow D1$
Value of Taylor series with coefficients Y at point X

138 $(A! X) \times (Y * A) \times (1 - Y) * X - A \leftarrow -\square I0 - i X + 1$ $X \leftarrow I0; Y \leftarrow D0$
Binomial distribution of X trials with probability Y

139 $\div Y \times (X - 1)! Y + X - 1$ $X \leftarrow D0; Y \leftarrow D0$
Beta function

140 $(* - Y) \times (Y * X) \div !X$ $X \leftarrow I; Y \leftarrow D0$
Poisson distribution of states X with average number Y

141 $!X - 1$ $X \leftarrow D0$
Gamma function

142 $Y! X$ $X \leftarrow D; Y \leftarrow D$
Number of combinations of X objects taken Y at a time

OUTER PRODUCT . . .

143 $\Phi X \dots = (1 \ 1 \ \Phi \lt \ \backslash X \dots = X) / X$ $X \leftarrow D1$
'Position' matrix of a vector

144 $' \ \square' [\square I0 + (\Phi i \lceil / A) \dots \leq A \leftarrow + / (i 1 + (\lceil / X) - \lfloor / X) \dots = X]$ $X \leftarrow I1$
Histogram (distribution barchart; down the page)

145 $+ / ((-1 \downarrow Y) \dots \leq X) \wedge (1 \downarrow Y) \dots > X$ $X \leftarrow D; Y \leftarrow D1$
Distribution of X into intervals between Y

146 $Y \dots \times (1 + G \div 100) \dots * X$ $X \leftarrow D; Y \leftarrow D; G \leftarrow D$
Compound interest for principals Y at rates G % in times X

147 $(Y[A \dots + -1 + i p X] \wedge = X) / A \leftarrow (A = 1 \uparrow X) / i p A \leftarrow (1 - p X) \downarrow Y$ $X \leftarrow A1; Y \leftarrow A1$
Occurrences of string X in string Y

148 $(1 \ -1 \ \dots = \Phi X) + . \times i 1 \uparrow p X$ $X \leftarrow I2 (1 = START; -1 = END)$
Transforming connection matrix X into a node matrix

149 $0 + . \# ((10 * Y) \times 10 * \square I0 - i Y + 1) \dots . \mid \lceil X \times 10 * Y$ $X \leftarrow D; Y \leftarrow I0$
Number of decimals (up to Y) of elements of X

150 $X + . \times Y \dots = ((i p Y) = Y \downarrow Y) / Y$ $X \leftarrow D1 Y \leftarrow D1$
Sum over elements of X determined by elements of Y

151 $(F\ A)+.x(A\leftarrow((\iota\ \rho X)=X\iota X)/X)\dots=X$ $X\leftarrow A1$
Executing costly monadic function F on repetitive arguments

152 $(G\dots=X)+.xY$ $X\leftarrow A; Y\leftarrow D; G\leftarrow A$
Sums according to codes G

153 $1\dots/\wedge\ 1\ 2\ 1\ 3\dots Y\dots=X$ $X\leftarrow A2; Y\leftarrow A2$
'X_iY' by rows for elements of matrices

154 $(1\ 1\dots\wedge\ X\dots=X)/X$ $X\leftarrow A1$
Removing duplicate elements (nub)

155 $\Gamma/(\wedge/0=A\dots|X)/A\leftarrow\iota\Gamma/X$ $X\leftarrow I1$
Greatest common divisor of elements of X

156 $+/(A\times X\div\Gamma/A\leftarrow Y-\Gamma/Y)\dots.\geq-1+iX$ $X\leftarrow I0; Y\leftarrow D1$
Classification of elements Y into X classes of equal size

157 $-/(\iota\Gamma/,X)\dots=\Phi X$ $X\leftarrow I2$ ($X[1;]=START; X[2;]=END$)
Transforming node matrix X into a connection matrix

158 $\wedge/1=+/X\dots=\iota\ \rho X$ $X\leftarrow I1$
Test if X is a permutation vector

159 $v/\wedge/0\ 1\dots=X$ $X\leftarrow B1$
Test if all elements of vector X are equal

160 $(\rho X)\rho\{,(+/A)\dots>-\Box I0-\iota^{-1}\uparrow\rho X)\backslash\{,A\leftarrow X\neq' ')\}/,X$ $X\leftarrow C$
Moving all blanks to end of each row

161 $\wedge/, (0\neq X)\leq A\dots\leq A\leftarrow\iota\ 1\uparrow\rho X$ $X\leftarrow D2$
Test if X is an upper triangular matrix

162 $\wedge/, (0\neq X)\leq A\dots\geq A\leftarrow\iota\ 1\uparrow\rho X$ $X\leftarrow D2$
Test if X is a lower triangular matrix

163 $+f(\Box I0-\iota\ \rho X)\Phi X\dots\times Y, 0\times 1\downarrow X$ $X\leftarrow D1; Y\leftarrow D1$
Product of two polynomials with coefficients X and Y

164 $0=(\iota\Gamma/X)\dots|X$ $X\leftarrow I1$
Divisibility table

165 $X\dots<\Phi\iota\Gamma/X$ $X\leftarrow I1$
Matrix with X[i] trailing zeroes on row i

166 $'\ \Box'[\Box I0+(\Phi\iota\Gamma/X)\dots\leq X]$ $X\leftarrow I1$
Barchart of integer values (down the page)

167 $X\dots\geq\Phi\iota\Gamma/X$ $X\leftarrow I1$
Matrix with X[i] trailing ones on row i

168 $X\dots<\iota\Gamma/X$ $X\leftarrow I1$
Matrix with X[i] leading zeroes on row i

169	$X \circ . \geq \lceil / X, 0$	$X \leftarrow I1$
	<i>Comparison table</i>	
170	' $\square' [\square I0 + X \circ . \geq (\lceil / X) \times (\lceil Y) \div Y]$	$X \leftarrow D1; Y \leftarrow D0$
	<i>Barchart of X with height Y (across the page)</i>	
171	' $\square' [\square I0 + X \circ . \geq \lceil / X]$	$X \leftarrow I1$
	<i>Barchart of integer values (across the page)</i>	
172	$X \circ . \geq \lceil / X$	$X \leftarrow I1$
	<i>Matrix with $X[i]$ leading ones on row i</i>	
173	$+ / (\lceil Y) \circ . = \lceil (X - G) \div H$	$X \leftarrow D; Y \leftarrow I0; G \leftarrow D0; H \leftarrow D0$
	<i>Division to Y classes with width H, minimum G</i>	
174	$1 2 1 \Phi X \circ . - \lceil / X$	$X \leftarrow D2$
	<i>Move set of points X into first quadrant</i>	
175	$(2 = + \# 0 = (\lceil X) \circ . \lceil \lceil X) / \lceil X$	$X \leftarrow I0$
	<i>All primes up to X</i>	
176	$(\wedge f(-1 + \lceil \rho X) \Phi (X \circ . = Y), 0) / \lceil 1 + \rho Y$	$X \leftarrow C1; Y \leftarrow C1$
	<i>Occurrences of string X in string Y</i>	
177	$\square I0 + + / Y \circ . \geq (' ' = X) / \lceil \rho X$	$X \leftarrow C1; Y \leftarrow I$
	<i>Ordinal numbers of words in X that indices Y point to</i>	
178	$(\wedge f(-1 + \lceil \rho X) \Phi X \circ . = Y) \lceil 1$	$X \leftarrow A1; Y \leftarrow A1$
	<i>First occurrence of string X in string Y</i>	
179	$Y[+ \# Y \circ . \leq X]$	$X \leftarrow D0; Y \leftarrow D1$
	<i>Contour levels Y at points with altitudes X</i>	
180	$\# / X \circ . \geq Y$	$X \leftarrow D; Y \leftarrow D1$
	<i>Test if X is within range [Y[1], Y[2]]</i>	
181	$+ / X \circ . \geq 0 50 100 1000$	$X \leftarrow D$
	<i>Which class do elements of X belong to</i>	
182	$(((-1 \Phi \sim A) \wedge A \leftarrow (-1 \downarrow X = 1 \Phi X), 0) / Y) \circ . = Y$	$X \leftarrow A1; Y \leftarrow A1$
	<i>Repeat matrix</i>	
183	$(\lceil X) \circ . \lceil \lceil X$	$X \leftarrow I0$
	<i>Maximum table</i>	
184	$(, Y \circ . > \Phi (\lceil G) - \square I0) \backslash X$	$X \leftarrow A1; Y \leftarrow I1; G \leftarrow I0$
	<i>Justifying right fields of X (lengths Y) to length G</i>	
185	$(, Y \circ . > (\lceil G) - \square I0) \backslash X$	$X \leftarrow A1; Y \leftarrow I1; G \leftarrow I0$
	<i>Justifying left fields of X (lengths Y) to length G</i>	
186	$((\rho A) \rho Y \div 100) \div A \leftarrow \Phi 1 - (1 + Y \div 100) \circ . \ast - X$	$X \leftarrow I; Y \leftarrow D$
	<i>Annuity coefficient: X periods at interest rate Y %</i>	

187	$1 \ 3 \ 2 \ 4 @ X \circ . \times Y$	$X \leftarrow D2; \ Y \leftarrow D2$
	<i>Direct matrix product</i>	
188	$1 \ 2 \ 1 \ 2 @ X \circ . \times Y$	$X \leftarrow D2; \ Y \leftarrow D2$
	<i>Shur product</i>	
189	$1 \ 2 \ 2 @ Y \circ . + X$	$X \leftarrow D1; \ Y \leftarrow D2$
	<i>Adding X to each row of Y</i>	
190	$2 \ 1 \ 2 @ X \circ . + Y$	$X \leftarrow D1; \ Y \leftarrow D2$
	<i>Adding X to each row of Y</i>	
191	$1 \ 2 \ 1 \ 2 @ X \circ . + Y$	$X \leftarrow D2; \ Y \leftarrow D2$
	<i>Matrix sum</i>	
192	$1 \ 2 \ 1 @ Y \circ . + X$	$X \leftarrow D1; \ Y \leftarrow D2$
	<i>Adding X to each column of Y</i>	
193	$1 \ 1 \ 2 @ X \circ . + Y$	$X \leftarrow D1; \ Y \leftarrow D2$
	<i>Adding X to each column of Y</i>	
194	$G @ X \circ . \alpha Y$	$X \leftarrow A; \ Y \leftarrow A; \ G \leftarrow I1$
	<i>Selecting specific elements from a 'large' outer product</i>	
195	$(iX) \circ . \leq iX$	$X \leftarrow I0$
	<i>$X \times X$ upper triangular matrix</i>	
196	$(iX) \circ . \geq iX$	$X \leftarrow I0$
	<i>$X \times X$ lower triangular matrix</i>	
197	$(iX) \circ . = iX$	$X \leftarrow I0$
	<i>$X \times X$ identity matrix</i>	
198	$\frac{1}{i} + (iX) \circ . + iX$	$X \leftarrow I0$
	<i>Hilbert matrix of order X</i>	
199	$(iX) \circ . \times iX$	$X \leftarrow I0$
	<i>Multiplication table</i>	
200	$X[;, (Yp1) \circ . \times i(pX)[2];]$	$Y \leftarrow I0; \ X \leftarrow A3$
	<i>Replicating a dimension of rank three array X Y-fold</i>	
201	$(0, i(pX) - Y) \circ . + Y$	$X \leftarrow A1 \ Y \leftarrow I0$
	<i>Moving index of width Y for vector X</i>	
202	$X \circ . + iY$	$X \leftarrow I1; \ Y \leftarrow I0$
	<i>Indices of subvectors of length Y starting at X+1</i>	
203	$X \circ . + , 0$	$X \leftarrow D1$
	<i>Reshaping numeric vector X into a one-column matrix</i>	
204	$X \circ . \times 1 \ - 1$	$X \leftarrow D$
	<i>Array and its negative ('plus minus')</i>	

INNER PRODUCT $\alpha \cdot \omega$

205 $(-2 \uparrow + / \wedge \Phi X \wedge . = ' ') \downarrow X$ $X \leftarrow C2$
Removing trailing blank rows

206 $((A \downarrow A) = \downarrow \rho A \leftarrow \square I O + + \# \wedge X v . \# \Phi X) \downarrow X$ $X \leftarrow A2$
Removing duplicate rows

207 $\square I O + + \# \wedge X v . \# \Phi Y$ $X \leftarrow A2; Y \leftarrow A2$
'X \downarrow Y' for rows of matrices

208 $(1 1 \Phi < \wedge X \wedge . = \Phi X) \downarrow X$ $X \leftarrow A2$
Removing duplicate rows

209 $(\Phi v \downarrow \Phi' ' v . \# X) / X$ $X \leftarrow C2$
Removing trailing blank columns

210 $(v \downarrow ' ' v . \# X) / X$ $X \leftarrow C2$
Removing leading blank columns

211 $(v \downarrow X v . \# ' ') \downarrow X$ $X \leftarrow C2$
Removing leading blank rows

212 $(X[1 \downarrow A]) [1 \downarrow A \leftarrow (2 2 \rho^{-1} 1 1 1 -.1) + . \times 10 * (-1 \downarrow Y), - / Y + Y > 99 0$ $X \leftarrow D; Y \leftarrow I1$
Limits X to fit in Y field Y[1 2]

213 $A + (X - A \downarrow \downarrow / X) \downarrow . \times Y$ $X \leftarrow A1; Y \leftarrow B$
Maxima of elements of subsets of X specified by Y

214 $X \wedge . = v / X$ $X \leftarrow B1$
Test if all elements of vector X are equal

215 $X \wedge . = \wedge / X$ $X \leftarrow B1$
Test if all elements of vector X are equal

216 $((((1 \uparrow \rho X), \rho Y) \uparrow X) \wedge . = Y) \downarrow X$ $X \leftarrow A2; Y \leftarrow A1$
Rows of matrix X starting with string Y

217 $(' ' \# X) \downarrow . \times \downarrow 1 \uparrow \rho X$ $X \leftarrow C$
Indices of last non-blanks in rows

218 $(A v 1 \downarrow 1 \Phi 1, A \leftarrow X v . \# ' ') \downarrow X$ $X \leftarrow C2$
Removing duplicate blank rows

219 $((-A) \downarrow X \wedge . = (A, 1 + \rho Y) \rho Y) / \downarrow (\rho Y) + 1 - A \leftarrow \rho X$ $X \leftarrow A1; Y \leftarrow A1$
Occurrences of string X in string Y

220 $(A v 1, -1 \downarrow A \leftarrow ' ' v . \# X) / X$ $X \leftarrow C2$
Removing duplicate blank columns

221 $\sim X \leq . \geq ([X], G, H)$ $X \leftarrow I0; G \leftarrow I0; H \leftarrow I0$
Test if X is an integer within range [G, H]

222	$Y\Gamma .\times X$ <i>Maximum of X with weights Y</i>	$X \leftarrow D1; Y \leftarrow D1$
223	$Y\Gamma .\times X$ <i>Minimum of X with weights Y</i>	$X \leftarrow D1; Y \leftarrow D1$
224	$X \leftarrow X\Gamma .+X$ <i>Extending a distance table to next leg</i>	$X \leftarrow B2$
225	$(Xv.\# ' ') \neq X$ <i>Removing blank rows</i>	$X \leftarrow C2$
226	$(' 'v.\# X) / X$ <i>Removing blank columns</i>	$X \leftarrow C2$
227	$(X * -1 + \rho Y) + . \times \Phi Y$ <i>Value of polynomial with coefficients Y at point X</i>	$X \leftarrow D0; Y \leftarrow D$
228	$1 \in X \wedge . = Y$ <i>Test if vector Y is a row of array X</i>	$X \leftarrow A; Y \leftarrow A1$
229	$(Y \wedge . = X) \downarrow 1$ <i>First occurrence of string X in matrix Y</i>	$X \leftarrow A2; Y \leftarrow A1; -1 \uparrow \rho Y \leftrightarrow \rho X$
230	$X \leftarrow Xv.\wedge X$ <i>Extending a transitive binary relation</i>	$X \leftarrow B2$
231	$Xv.\# Y$ <i>Test if rows of X contain elements differing from Y</i>	$X \leftarrow A; Y \leftarrow A0$
232	$X \wedge . = Y$ <i>Comparing vector Y with rows of array X</i>	$X \leftarrow A; Y \leftarrow A1$
233	$X < . < Y$ <i>Test if X is within range [Y[1;], Y[2;]]</i>	$X \leftarrow D0; Y \leftarrow D2; 1 \uparrow \rho Y \leftrightarrow 2$
234	$X < . \leq Y$ <i>Test if X is within range (Y[1;], Y[2;]]</i>	$X \leftarrow D; Y \leftarrow D2; 1 \uparrow \rho Y \leftrightarrow 2$
235	$(X, [.1 + \rho \rho X] X) > . > Y$ <i>Test if X is within range (Y[1;], Y[2;]]</i>	$X \leftarrow D; Y \leftarrow D2; 1 \uparrow \rho Y \leftrightarrow 2$
236	$X + . = , Y$ <i>Number of occurrences of scalar X in array Y</i>	$X \leftarrow A0; Y \leftarrow A$
237	$(Y + . \times X) \div \rho X$ <i>Arithmetic average (mean value) of X weighted by Y</i>	$X \leftarrow D1; Y \leftarrow D1$
238	$Y - . \div X$ <i>Sum of alternating reciprocal series $Y \div X$</i>	$X \leftarrow D1; Y \leftarrow D1$
239	$Y + . \div X$ <i>Sum of reciprocal series $Y \div X$</i>	$X \leftarrow D1; Y \leftarrow D1$

240	$X+.\times Y$ <i>Matrix product</i>	$X \leftarrow D; Y \leftarrow D; \neg 1 \uparrow \rho X \leftrightarrow 1 \uparrow \rho Y$
241	$X+.\times Y$ <i>Summation over subsets of X specified by Y</i>	$X \leftarrow A1; Y \leftarrow B$
242	$X+.\times X$ <i>Sum of squares of X</i>	$X \leftarrow D1$
243	$Y+.\times X$ <i>Scalar (dot) product of vectors</i>	$X \leftarrow D1; Y \leftarrow D1$
244	$X \times . \times Y$ <i>Products over subsets of X specified by Y</i>	$X \leftarrow A1; Y \leftarrow B$
245	$\square RL \leftarrow \square TS+.\times 2$ <i>Randomizing random numbers (in $\square LX$ in a workspace)</i>	
246	$X+.\times 2$ <i>Sum of squares of X</i>	$X \leftarrow D1$
---	<i>SCAN $\omega \backslash \omega \wedge$</i>	
247	$(i+/X, Y) \epsilon+ \backslash 1 \neg 1 \downarrow 0, ((i+/X) \epsilon+ \backslash X) \backslash Y$ <i>Vector $(X[1] \rho 1), (Y[1] \rho 0), (X[2] \rho 1), \dots$</i>	$Q \leftarrow I1; Y \leftarrow I1$
248	$(A-10.5 \times (A \leftarrow +/\wedge \Phi A) \leftarrow +/\wedge \backslash A \leftarrow ' = \Phi X) \Phi X$ <i>Centering character array X with ragged edges</i>	$X \leftarrow C$
249	$\square IO \leftarrow +\backslash 1 + ((i+/X) \epsilon+ \backslash \square IO, X) \backslash Y \neg 1 \downarrow 1, X+Y$ <i>Vector $(Y[1]+_1 X[1]), (Y[2]+_1 X[2]), (Y[3]+_1 X[3]), \dots$</i>	$X \leftarrow I1; Y \leftarrow I1; \rho X \leftrightarrow \rho Y$
250	$Y[+] \backslash (i+/X) \epsilon- 1 \downarrow 1 \leftarrow +\backslash 0, X$ <i>Replicate $Y[i]$ $X[i]$ times (for all i)</i>	$X \leftarrow I1; Y \leftarrow A1; \wedge/0 \leftarrow X$
251	$((X \neq 0) / Y) [+] \neg 1 \Phi (i+/X) \epsilon+ \backslash X$ <i>Replicate $Y[i]$ $X[i]$ times (for all i)</i>	$X \leftarrow I1; Y \leftarrow A1$
252	$\# \backslash (i+/X) \epsilon+ \backslash \square IO, X$ <i>Vector $(X[1] \rho 1), (X[2] \rho 0), (X[3] \rho 1), \dots$</i>	$X \leftarrow I1; \wedge/0 \leftarrow X$
253	$Y[\square IO \leftarrow +\backslash (i+/X) \epsilon \square IO \leftarrow +\backslash X]$ <i>Replicate $Y[i]$ $X[i]$ times (for all i)</i>	$X \leftarrow I1; Y \leftarrow A1; \wedge/0 \leftarrow X$
254	$\# \backslash Y \# X \backslash A \neg 1 \downarrow 0, A \leftarrow X / \# \neg 1 \downarrow 0, Y$ <i>Running parity (# \backslash) over subvectors of Y indicated by X</i>	$X \leftarrow B1; Y \leftarrow B1$
255	$+ \backslash Y - X \backslash A \neg 1 \downarrow 0, A \leftarrow X / + \neg 1 \downarrow 0, Y$ <i>Cumulative sum (+ \backslash) over subvectors of Y indicated by X</i>	$X \leftarrow B1; Y \leftarrow D1$
256	$Y \wedge A = [\backslash X \times A \leftarrow + \backslash Y \rangle \neg 1 \downarrow 0, Y$ <i>Groups of ones in Y pointed by X (or trailing parts)</i>	$X \leftarrow B; Y \leftarrow B$

257	$A \leftarrow \sum_i A_i \otimes X_i$	$X \leftarrow D_1; Y \leftarrow I_1$
	<i>Sums over (+/>) subvectors of X, lengths in Y</i>	
258	$(pX) \rho A \leftarrow (A \leftarrow, \wedge \{ ('a' \neq X) \vee \#X = 1 \}) /, X$	$X \leftarrow C_2$
	<i>Decommenting a matrix representation of a function (□CR)</i>	
259	$((\Phi v \rho A) \wedge v \rho A \leftarrow ' ' \neq X) / X$	$X \leftarrow C_1$
	<i>Removing leading and trailing blanks</i>	
260	$+ \sum_i X_i$	$X \leftarrow I_0$
	<i>X first figurate numbers</i>	
261	$X \wedge \wedge \rho X = v \rho X$	$X \leftarrow B$
	<i>First group of ones</i>	
262	$(\langle \rangle, (X = (pX) \rho \{ fX \} \wedge X = \emptyset \{ (\Phi pX) \rho \{ l/X \} \}) /, X$	$X \leftarrow D_2$
	<i>Value of saddle point</i>	
263	$((\sim (pA \uparrow X) \uparrow ' ' = Y) / A \uparrow X), (1 \downarrow A \downarrow Y), (A \leftarrow + \wedge \{ Y \neq ' ' \}) \downarrow X$	$X \leftarrow C_1; Y \leftarrow C_1$
	<i>Editing X with Y ▽-wise</i>	
264	$((i(pY) \uparrow \uparrow / X) \epsilon + \downarrow 1 \downarrow 0, \sim 1 \downarrow ((i(pY) \epsilon G) \rho X) \downarrow Y$	$X \leftarrow I_1; Y \leftarrow A_1; G \leftarrow I_1$
	<i>Open a gap of X[i] after Y[G[i]] (for all i)</i>	
265	$(i(pY) \uparrow \uparrow / X) \epsilon + \downarrow 1 \downarrow 0, (1 \Phi Y) \rho X$	$X \leftarrow I_1; Y \leftarrow B_1$
	<i>Insert vector for X[i] zeroes after i:th subvector</i>	
266	$(- + \wedge \{ ' ' = \Phi X \}) \downarrow X$	$X \leftarrow C_1$
	<i>Removing trailing blanks</i>	
267	$(+ \wedge \{ ' ' = X \}) \downarrow X$	$X \leftarrow C_1$
	<i>Removing leading blanks</i>	
268	$\wedge / [Y] X = [\wedge [Y] X$	$X \leftarrow D; Y \leftarrow I_0$
	<i>Test if X is in ascending order along direction Y</i>	
269	$(- \lfloor 0.5 \times + \wedge \{ ' ' = \Phi X \} \Phi X$	$X \leftarrow C$
	<i>Centering character array X with only right edge ragged</i>	
270	$\wedge / [Y] X = [\wedge [Y] X$	$X \leftarrow D; Y \leftarrow I_0$
	<i>Test if X is in descending order along direction Y</i>	
271	$((i(pY) \uparrow \uparrow / X) \epsilon + \downarrow 1 + ((i(pY) \epsilon G) \rho X) \downarrow Y$	$X \leftarrow I_1; Y \leftarrow A_1; G \leftarrow I_1$
	<i>Open a gap of X[i] before Y[G[i]] (for all i)</i>	
272	$(\Phi v \rho v \{ ' ' \neq X \}) / X$	$X \leftarrow C_2$
	<i>Removing trailing blank columns</i>	
273	$X, [\square I_0 - (\wedge 2 \rho \wedge / 2) \rho \rho X, \rho \rho Y] / .5 0] Y$	$X \leftarrow A; Y \leftarrow A$
	<i>Vectors as matrices in catenation</i>	
274	$X, [\square I_0 + (\wedge 2 \rho \wedge / 2) \rho \rho X, \rho \rho Y] / .5 1] Y$	$X \leftarrow A; Y \leftarrow A$
	<i>Vectors as matrices in catenation</i>	

275	$(-/\wedge\backslash' '=\phi X)\phi X$	$X \leftarrow C$
	<i>Justifying right</i>	
276	$(+/\wedge\backslash' '=\chi)\phi X$	$X \leftarrow C$
	<i>Justifying left</i>	
277	$(i+/X)\epsilon(+\backslash X)-\sim \square I0$	$X \leftarrow I1$
	<i>Changing lengths of subvectors to ending indicators</i>	
278	$(i+/X)\epsilon+\square I0, X$	$X \leftarrow I1$
	<i>Changing lengths of subvectors to starting indicators</i>	
279	$(i+/A)\epsilon+\backslash A \leftarrow 1+X$	$X \leftarrow I1$
	<i>Insert vector for $X[i]$ elements before i:th element</i>	
280	$(+\backslash X)i \leftarrow +/X$	$X \leftarrow B1$
	<i>Indices of ones in logical vector X</i>	
281	$+/Y \times \backslash 1, X \div i \leftarrow 1+pY$	$X \leftarrow D0; Y \leftarrow D1$
	<i>Value of Taylor series with coefficients Y at point X</i>	
282	$\square I0 \leftarrow +/\wedge\backslash' ' \neq X$	$X \leftarrow C$
	<i>Indices of first blanks in rows of array X</i>	
283	$(Y=+\backslash X \leftarrow 1+X)/X$	$Y \leftarrow I0; X \leftarrow C1$
	<i>Locating field number Y starting with first element of X</i>	
284	$A \leftarrow -1 \leftarrow 0, A \leftarrow (Y \neq 1+Y, 0)/+\backslash X$	$X \leftarrow D1; Y \leftarrow D1$
	<i>Sum elements of X marked by succeeding identicals in Y</i>	
285	$((Y-1) \leftarrow A) \leftarrow 0, (-Y) \leftarrow A \leftarrow +\backslash X$	$X \leftarrow D1; Y \leftarrow I0$
	<i>Running sum of Y consecutive elements of X</i>	
286	$G \leftarrow -1 \leftarrow 0, G \leftarrow 0 \lceil (+\backslash Y)-X$	$Y \leftarrow D1; X \leftarrow D0$
	<i>Fifo stock Y decremented with X units</i>	
287	$A \leftarrow -1 \leftarrow 0, A \leftarrow 2 \lceil +\backslash X = ' ' '$	$X \leftarrow C1$
	<i>Locations of texts between and including quotes</i>	
288	$A \leftarrow -1 \leftarrow 0, A \leftarrow 2 \lceil +\backslash X = ' ' '$	$X \leftarrow C1$
	<i>Locations of texts between quotes</i>	
289	$\neq \backslash (Y \vee X) \backslash A \leftarrow -1 \leftarrow 0, A \leftarrow (Y \vee X)/Y$	$X \leftarrow B1; Y \leftarrow B1$
	<i>Or-scan ($\vee \backslash$) over subvectors of Y indicated by X</i>	
290	$\sim \neq \backslash (Y \leq X) \backslash A \leftarrow -1 \leftarrow 0, A \leftarrow \sim (Y \leq X)/Y$	$X \leftarrow B1; Y \leftarrow B1$
	<i>And-scan ($\wedge \backslash$) over subvectors of Y indicated by X</i>	
291	$A \leftarrow -1 \leftarrow 0, A \leftarrow (1 \phi X)/+\backslash Y$	$X \leftarrow B1; Y \leftarrow D1$
	<i>Sums over (+/) subvectors of Y indicated by X</i>	
292	$Y \wedge A \epsilon (X \wedge Y) / A \leftarrow +\backslash Y > -1 \leftarrow 0, Y$	$X \leftarrow B1; Y \leftarrow B1$
	<i>Groups of ones in Y pointed by X</i>	

293	$A \vee^{-1 \downarrow 0}, A \leftarrow \# \backslash X = ' ' '$	$X \leftarrow C1$
	<i>Locations of texts between and including quotes</i>	
294	$A \wedge^{-1 \downarrow 0}, A \leftarrow \# \backslash X = ' ' '$	$X \leftarrow C1$
	<i>Locations of texts between quotes</i>	
295	$+ \backslash ('(' = X) -^{-1 \downarrow 0}, ')') = X$	$X \leftarrow C1$
	<i>Depth of parentheses</i>	
296	$+ \backslash^{-1 \downarrow 0} I0, X$	$X \leftarrow I1$
	<i>Starting positions of subvectors (lengths in X)</i>	
297	$X[1 \ll \backslash Y \times \downarrow \rho Y]$	$X \leftarrow A1; Y \leftarrow B1$
	<i>Duplicating element of X belonging to Y, 1 \uparrow X until next found</i>	
298	$(\Phi \vee \Phi' ' \neq X) / X$	$X \leftarrow C1$
	<i>Removing trailing blanks</i>	
299	$(\vee ' ' \neq X) / X$	$X \leftarrow C1$
	<i>Removing leading blanks</i>	
300	$(G = + \backslash X) / Y$	$X \leftarrow A1; Y \leftarrow B1; G \leftarrow I0$
	<i>G:th subvector of Y (subvectors indicated by X)</i>	
301	$- \backslash \downarrow X$	$X \leftarrow I0$
	<i>Alternating series (1 -1 2 -2 3 -3 ...)</i>	
302	$+ \backslash \downarrow X$	$X \leftarrow I0$
	<i>X first triangular numbers</i>	
303	$X \vee \# \backslash X$	$X \leftarrow B$
	<i>Joining pairs of ones</i>	
304	$\vee \backslash X$	$X \leftarrow B$
	<i>Turn on all zeroes after first one</i>	
305	$(\sim X) \wedge \# \backslash X$	$X \leftarrow B$
	<i>Places between pairs of ones</i>	
306	$\wedge \backslash X$	$X \leftarrow B$
	<i>Turn off all ones after first zero</i>	
307	$< \backslash X$	$X \leftarrow B$
	<i>Turn off all ones after first one</i>	
308	$\leq \backslash X$	$X \leftarrow B$
	<i>Turn on all zeroes after first zero</i>	
309	$\# \backslash X$	$X \leftarrow B$
	<i>Running parity</i>	
310	$+ \backslash X$	$X \leftarrow D$
	<i>Cumulative sum</i>	

REDUCTION w/ wt

311	$(\top/X)=\bot/X$	$X \leftarrow D1$
	Test if all elements of vector X are equal	
312	$(\top/X)=\bot/X$	$X \leftarrow D1$
	Size of range of elements of X	
313	$-\bot/X \neq 0 \ 1\Phi X$	$X \leftarrow D2$
	Evaluating a two-row determinant	
314	$-\bot/X \neq 0 \ 1\Theta X$	$X \leftarrow D2$
	Evaluating a two-row determinant	
315	$(\wedge/X) \vee \sim \vee/X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
316	$(\wedge/X)=\vee/X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
317	$\wedge/X \div \vee/X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
318	$(\times/(\top/X \div 2) - 0, X) * .5$	$X \leftarrow D1; 3 \leftrightarrow \rho X$
	Area of triangle with side lengths in X (Heron's formula)	
319	$((\top/(\top/X - (\top/X \div \rho X) * 2) \div \rho X) * .5$	$X \leftarrow D1$
	Standard deviation of X	
320	$((\top/(\top/X - (\top/X \div \rho X) * 2) \div \rho X) * 2) \div \rho X$	$X \leftarrow D1$
	Variance (dispersion) of X	
321	$((\top/(\top/X - (\top/X \div \rho X) * 2) \div \rho X) * Y) \div \rho X$	$X \leftarrow D1$
	Y:th moment of X	
322	$\wedge/((1\top X) \epsilon 10\downarrow A), X \in A \leftarrow '0..9A..Z\Delta A..X\Delta'$	$X \leftarrow C1$
	Test if X is a valid APL name	
323	$Y\uparrow((l - .5 \times Y, \rho X) \rho''), X$	$X \leftarrow C1; Y \leftarrow I0$
	Centering text line X into a field of width Y	
324	$\wedge/X = 1\top X$	$X \leftarrow A1$
	Test if all elements of vector X are equal	
325	$(\top/X) \div -1\uparrow 1, \rho X$	$X \leftarrow D2$
	Average (mean value) of rows of matrix X	
326	$(\top/X) \div 1\uparrow(\rho X), 1$	$X \leftarrow D2$
	Average (mean value) of columns of matrix X	
327	$(-\bot\Phi 1\downarrow(\vee/X \neq -1\Theta X), 1) \div X$	$X \leftarrow A2$
	Removing duplicate rows from ordered matrix X	

328	$x/-1 \downarrow \rho X$	$X \leftarrow A$
	Number of rows in array X (also of a vector)	
329	$(\downarrow \Gamma / X) \epsilon X$	$X \leftarrow I1$
	Converting set of positive integers X into a mask	
330	$X \downarrow \Gamma / X$	$X \leftarrow D1$
	Index of (first) maximum element of X	
331	$\Gamma / \downarrow 0$	
	Negative infinity; the smallest representable value	
332	$(+/, X) \div 1 \Gamma \rho, X$	$X \leftarrow D$
	Arithmetic average (mean value), also for an empty array	
333	$A[X] \Delta A[Y] \leftarrow 1 \Delta A \leftarrow (\Gamma / X, Y) \rho 0$	$X \leftarrow I1; Y \leftarrow I1$
	Quick membership (ϵ) for positive integers	
334	$\Gamma / X, 0$	$X \leftarrow D1$
	Positive maximum, at least zero (also for empty X)	
335	Γ / X	$X \leftarrow D1$
	Maximum of elements of X	
336	$X \downarrow \Gamma / X$	$X \leftarrow D1$
	Index of (first) minimum element of X	
337	$\Gamma / \downarrow 0$	
	Positive infinity; the largest representable value	
338	$\Gamma / X \downarrow Y$	$X \leftarrow C1; Y \leftarrow C1$
	Index of first occurrence of elements of Y	
339	Γ / X	$X \leftarrow D1$
	Minimum of elements of X	
340	$0 = (\rho X) \downarrow + / X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
341	$\wedge / X / 1 \Phi X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
342	$+ / A x - 1 * A < 1 \Phi A \leftarrow 0, 1000 500 100 50 10 5 1 ['MDCLXVI' \downarrow X]$	$X \leftarrow A$
	Interpretation of roman numbers	
343	$\wedge / X = 1 \Phi X$	$X \leftarrow A1$
	Test if all elements of vector X are equal	
344	$\wedge / X = 1 \Theta X$	$X \leftarrow A2$
	Comparison of successive rows	
345	$\wedge / (X \epsilon Y), Y \epsilon X$	$X \leftarrow A1; Y \leftarrow A1$
	Identity of two sets	

346	$\wedge/(\iota\rho X) \in X$	$X \leftarrow I1$
	Test if X is a permutation vector	
347	$\wedge/0 \ i \in X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
348	$\vee/Y \in X$	$X \leftarrow A; Y \leftarrow A1$
	Test if X and Y have elements in common	
349	$\sim\wedge/X \in \sim X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
350	$\wedge/, X \in 0 \ 1$	$X \leftarrow A$
	Test if X is boolean	
351	$\wedge/Y \in X$	$X \leftarrow A; Y \leftarrow A1$
	Test if Y is a subset of X ($Y \subset X$)	
352	$\#/\# 0 \ i \in X$	$X \leftarrow B1$
	Test if all elements of vector X are equal	
353	$\wedge/(X \in X) = \iota\rho X$	$X \leftarrow A1$
	Test if each element of X occurs only once	
354	$\wedge/\square I0 = X \in X$	$X \leftarrow A1$
	Test if all elements of vector X are equal	
355	$\sim\vee/X$	$X \leftarrow B$
	None, neither	
356	\vee/X	$X \leftarrow B$
	Any, anyone	
357	$\wedge/, X = Y$	$X \leftarrow A; Y \leftarrow A; \rho X \leftrightarrow \rho Y$
	Test if arrays of equal shape are identical	
358	$\wedge/X = X[1]$	$X \leftarrow A1$
	Test if all elements of vector X are equal	
359	$\wedge/'' = X$	$X \leftarrow C2$
	Blank rows	
360	\wedge/X	$X \leftarrow B$
	All, both	
361	$\#/X$	$X \leftarrow B$
	Parity	
362	$+/X =, Y$	$X \leftarrow A0; Y \leftarrow A$
	Number of occurrences of scalar X in array Y	
363	$(-X[2]-1 \ 1 \times ((X[2]*2)-\times/4, X[1 \ 3]) * .5) \div 2 \times X[1]$	$X \leftarrow D1; 3 \leftrightarrow \rho X$
	(Real) solution of quadratic equation with coefficients X	

364	$(+/[Y]X) \div (\rho X)[Y]$	$X \leftarrow D; Y \leftarrow I0$
	Average (mean value) of elements of X along direction Y	
365	$(+/X) \div \rho X$	$X \leftarrow D1$
	Arithmetic average (mean value)	
366	$\times / \rho X$	$X \leftarrow A$
	Number of elements (also of a scalar)	
367	\div / X	$X \leftarrow D$
	Alternating product	
368	\times / X	$X \leftarrow D1$
	Product of elements of X	
369	$- / X$	$X \leftarrow D$
	Alternating sum	
370	$+ / X$	$X \leftarrow B1$
	Number of elements satisfying condition X	
371	$+ / X$	$X \leftarrow A1$
	Reshaping one-element vector X into a scalar	
372	$+ / X$	$X \leftarrow D2$
	Column sum of a matrix	
373	$+ / X$	$X \leftarrow D2$
	Row sum of a matrix	
374	$+ / X$	$X \leftarrow D1$
	Sum of elements of X	
---	TAKE \uparrow	
375	$Y[[1G;], [1]((1 \downarrow \rho Y) \uparrow X), [1](2 \uparrow G) \downarrow Y$	$X \leftarrow A1; Y \leftarrow A2; G \leftarrow I0$
	Inserting vector X into matrix Y after row G	
376	$(A \uparrow X), [1](1 \downarrow A \leftarrow (\rho X)[0, \rho Y] \uparrow Y$	$X \leftarrow A2; Y \leftarrow A1$
	Inserting vector Y to the end of matrix X	
377	$Y \uparrow X, Y \rho^{-1} \uparrow X$	$X \leftarrow A1; Y \leftarrow I0$
	Filling X with last element of X to length Y	
378	$X[Y;] \leftarrow (1 \uparrow \rho X) \uparrow \square$	$X \leftarrow C2; Y \leftarrow I0$
	Input of row Y of text matrix X	
379	$(1 \uparrow A) \downarrow (A \& 1 \Phi A \leftarrow Y) / X$	$X \leftarrow A1; Y \leftarrow A0$
	Removing leading, multiple and trailing Y 's	
380	$X \leftarrow (\rho X) \rho A \Delta A[(A=1 \uparrow Y) / \square \rho A \leftarrow, X] \leftarrow 1 \downarrow Y$	$X \leftarrow A; Y \leftarrow A1$
	Changing elements in X with value $Y[1]$ into $Y[2]$	

381 $X > ((-\rho\rho X) \uparrow^{-1}) \downarrow 0, X$ $X \leftarrow B$
First ones in groups of ones

382 $(G \uparrow Y), X, G \downarrow Y$ $X \leftarrow A1; Y \leftarrow A1; G \leftarrow I0$
Inserting X into Y after index G

383 $X - ((-\rho\rho X) \uparrow^{-1}) \downarrow 0, X$ $X \leftarrow D$
Pairwise differences of successive columns (inverse of +\)

384 $((-\rho\rho X) \uparrow 1) \downarrow X, 0$ $X \leftarrow D$
Rightmost neighboring elements

385 $((-\rho\rho X) \uparrow^{-1}) \downarrow 0, X$ $X \leftarrow D$
Leftmost neighboring elements

386 $(-\rho X) \uparrow (-Y) \downarrow X$ $X \leftarrow A1; Y \leftarrow I0$
Shifting vector X right with Y without rotate

387 $(\rho X) \uparrow Y \downarrow X$ $X \leftarrow A1; Y \leftarrow I0$
Shifting vector X left with Y without rotate

388 $(2 \uparrow Y) \downarrow X$ $X \leftarrow A2; Y \leftarrow I0$
Drop of Y first rows from matrix X

389 $, \emptyset (A \rho 2) \rho (2 * A + [2 \otimes X]) \uparrow \downarrow X$ $X \leftarrow I0$
Playing order in a cup for X ranked players

390 $((1 \ 0 \times \rho Y) \Gamma \rho X) \uparrow X$ $X \leftarrow A2; Y \leftarrow A2$
Lengthening matrix X to be compatible with Y

391 $((0 \ 1 \times \rho Y) \Gamma \rho X) \uparrow X$ $X \leftarrow A2; Y \leftarrow A2$
Widening matrix X to be compatible with Y

392 $(1 \Gamma^{-2} \uparrow \rho X) \rho X$ $X \leftarrow A; 2 \geq \rho \rho X$
Reshaping non-empty lower-rank array X into a matrix

393 $(-l .5 \times Y + \rho X) \uparrow X$ $X \leftarrow C1; Y \leftarrow I0$
Centering text line X into a field of width Y

394 $(X \Gamma \rho Y) \uparrow Y$ $X \leftarrow I; Y \leftarrow A$
Take of at most X elements from Y

395 $(-1 \uparrow \rho Y) \Gamma (, Y) \downarrow X$ $Y \leftarrow C2; X \leftarrow C$
Alphabetizing X; equal alphabets in same column of Y

396 $(\sim (i^{-1} \uparrow \rho X) \epsilon Y) / X$ $X \leftarrow A; Y \leftarrow I1$
Removing columns Y from array X

397 $(-1 \uparrow (' ' \# X) / \downarrow \rho X) \rho X$ $X \leftarrow C1$
Removing trailing blanks

398 $(1 - i^{-1} \uparrow \rho X) \Phi X$ $X \leftarrow A2$
Aligning columns of matrix X to diagonals

399	$(-1+i-1+pX)\phi X$	$X \leftarrow A2$
	Aligning diagonals of matrix X to columns	
400	$0 \in 1 \uparrow 0 p X$	$X \leftarrow A$
	Test if numeric	
401	$(-1+X_i ' ') \uparrow X$	$X \leftarrow C1$
	First word in X	
402	$(-2 \uparrow 1 1, p X) p X$	$X \leftarrow A; 2 \geq p p X$
	Reshaping non-empty lower-rank array X into a matrix	
403	$1 \uparrow \square, X$	$X \leftarrow C0$
	Giving a character default value for input	
404	$(X \times Y) p (-Y) \uparrow 1$	$X \leftarrow I0; Y \leftarrow I0$
	Ending points for X fields of width Y	
405	$(X \times Y) p Y \uparrow 1$	$X \leftarrow I0; Y \leftarrow I0$
	Starting points for X fields of width Y	
406	$X + (-p X) \uparrow Y$	$X \leftarrow D; Y \leftarrow D0$
	Adding scalar Y to last element of X	
407	$Y \uparrow X p 1$	$X \leftarrow I0; Y \leftarrow I0$
	Vector of length Y with X ones on the left, the rest zeroes	
408	$1 80 p 80 \uparrow X$	$X \leftarrow A1$
	Forming first row of a matrix to be expanded	
409	$1 \uparrow 0 p X$	$X \leftarrow A$
	Zero or space depending on the type of X (fill element)	
410	$-1 \uparrow p X$	$X \leftarrow A2$
	Number of columns in matrix X	
411	$1 \uparrow p X$	$X \leftarrow A2$
	Number of rows in matrix X	
412	$(-Y) \uparrow X$	$Y \leftarrow I0; X \leftarrow C1$
	Transferring text X to right edge of field of width Y	
---	DROP ↓	
413	$(1 \uparrow A) - -1 \uparrow A \leftarrow (A, 1) / i 1 + p A \leftarrow 1, (1 \uparrow X) \neq -1 \uparrow X$	$X \leftarrow A1$
	Lengths of subvectors with equal elements	
414	$G - -1 \uparrow 0, G \leftarrow (\sim \square I0) + (((1 \uparrow X) \neq -1 \uparrow X), 1) / i p X$	$X \leftarrow A1; G \leftarrow I1$
	Field lengths of vector X; G ↔ ending indices	
415	$(A > 0) / A \leftarrow (1 \uparrow A) - 1 + -1 \uparrow A \leftarrow (\sim A) / i p A \leftarrow 0, X, 0$	$X \leftarrow B1$
	Lengths of groups of ones in X	

416 $((A_{1:1}) - \square I_0) \downarrow (\square I_0 - (\Phi A \leftarrow \sim X \in Y)_{1:1}) \downarrow X$ $X \leftarrow A_1; Y \leftarrow A$
Removing elements Y from beginning and end of vector X

417 $((1 \downarrow X) \neq -1 \downarrow X), 1$ $X \leftarrow A_1$
Ending points of equal groups

418 $1, (1 \downarrow X) \neq -1 \downarrow X$ $X \leftarrow A_1$
Starting points of equal groups

419 $(1 \downarrow X) \div -1 \downarrow X$ $X \leftarrow D_1$
Pairwise ratios of successive elements of vector X

420 $(1 \downarrow X) - -1 \downarrow X$ $X \leftarrow D_1$
Pairwise differences of successive elements of vector X

421 $(Y \wedge X) \vee (Y \vee X) \setminus A > -1 \downarrow 0, A \leftarrow (Y \vee X) / Y$ $X \leftarrow B_1; Y \leftarrow B_1$
First ones of subvectors of Y indicated by X (<\setminus)

422 $(-1 \Phi 1 \downarrow (X \neq -1 \Phi X), 1) / X$ $X \leftarrow A_1$
Removing duplicates from an ordered vector

423 $A = -1 \downarrow 0, A \leftarrow (1 \Phi X) / \downarrow \rho X$ $X \leftarrow B_1$
Changing starting indicators of subvectors to lengths

424 $(A \vee 1 \downarrow 1 \Phi 1, A \leftarrow ' ' \neq X) / X$ $X \leftarrow C_1$
Removing multiple blanks

425 $(\rho X) \rho A \Delta A[(A = 1 \rho Y) / \downarrow \rho A \leftarrow, X] \leftarrow 1 \downarrow Y$ $X \leftarrow A; Y \leftarrow A_1; 2 \leftrightarrow \rho Y$
Replacing all values Y[1] by Y[2] in X

426 $(A \vee -1 \downarrow 1, A \leftarrow X \neq Y) / X$ $X \leftarrow A_1; Y \leftarrow A_0$
Removing duplicate Y's from vector X

427 $(\square I_0 - (\sim \Phi X \in Y)_{1:1}) \downarrow X$ $X \leftarrow A_1; Y \leftarrow A$
Removing elements Y from end of vector X

428 $(1 - (\Phi ' ' \neq X)_{1:1}) \downarrow X$ $X \leftarrow C_1$
Removing trailing blanks

429 $0 \ -1 \downarrow (-\downarrow \rho X) \Phi ((2 \rho \rho X) \rho 0), X$ $X \leftarrow D_1$
Diagonal matrix with elements of X

430 $-1 \downarrow X \times \Phi -1 + \downarrow \rho X$ $X \leftarrow D_1$
Derivate of polynomial X

431 $(-1 \downarrow X \neq 1 \Phi X), 1$ $X \leftarrow A_1$
Test if an element differs from the next one

432 $1, 1 \downarrow X \neq -1 \Phi X$ $X \leftarrow A_1$
Test if an element differs from the previous one

433 $1 \Phi -1 \downarrow Y, X$ $X \leftarrow A_1; Y \leftarrow A_0$
Replacing last element of X with Y

434	${}^{-1}01 \downarrow X, Y$	$X \leftarrow A1; Y \leftarrow A0$
	<i>Replacing first element of X with Y</i>	
435	$(({}^{-1}01 \downarrow X) \downarrow 1) - \square I0 \downarrow X$	$X \leftarrow A1; Y \leftarrow A$
	<i>Removing elements Y from beginning of vector X</i>	
436	$X - ({}^{-1}01 \downarrow X) \downarrow 0, [Y]X$	$X \leftarrow D; Y \leftarrow I0$
	<i>Differences of successive elements of X along direction Y</i>	
437	${}^{-1}01 + (X = '0') \downarrow X$	$X \leftarrow A1$
	<i>Removing leading zeroes</i>	
438	$Y + (Y \downarrow X) \downarrow 1$	$G \leftarrow I0; X \leftarrow B1$
	<i>Index of first one after index Y in X</i>	
439	$X > 1 \downarrow X, 0$	$X \leftarrow B1$
	<i>Last ones in groups of ones</i>	
440	$X > {}^{-1}01 \downarrow X$	$X \leftarrow B1$
	<i>First ones in groups of ones</i>	
441	$1 \downarrow, ', ', X$	$X \leftarrow C2$
	<i>List of names in X (one per row)</i>	
442	$X - {}^{-1}01 \downarrow X$	$X \leftarrow D1$
	<i>Restoring argument of cumulative sum (inverse of +\)</i>	
443	$(0, Y) \downarrow X$	$X \leftarrow A2; Y \leftarrow I0$
	<i>Drop of Y first columns from matrix X</i>	
444	$(Y, 0) \downarrow X$	$X \leftarrow A2; Y \leftarrow I0$
	<i>Drop of Y first rows from matrix X</i>	
445	$1 \downarrow pX$	$X \leftarrow A2$
	<i>Number of columns in matrix X</i>	
446	${}^{-1}01 \downarrow pX$	$X \leftarrow A2$
	<i>Number of rows in matrix X</i>	
447	$(Y \times G) \downarrow X$	$X \leftarrow A; Y \leftarrow I1; G \leftarrow B1$
	<i>Conditional drop of Y elements from array X</i>	
448	$(-Y) \downarrow X$	$X \leftarrow A1; Y \leftarrow B0$
	<i>Conditional drop of last element of X</i>	
---	<i>CEILING / MAXIMUM</i>	
449	$Y[1] \square Y[2] \downarrow X$	$X \leftarrow D; Y \leftarrow D1$
	<i>Limiting X between Y[1] and Y[2], inclusive</i>	
---	<i>FLOOR / MINIMUM</i>	

450 $\lfloor 10^{\oplus} \rfloor 1-3 \times \div 3$
Arithmetic precision of the system (in decimals)

451 $X+(G \times Y-X) \times (1+1 \lfloor (Y-X) \div G \rfloor) - \square 10$ $X \leftarrow D0; Y \leftarrow D0; G \leftarrow D0$
Arithmetic progression from X to Y with step G

452 $1+(X<0)+\lfloor 10^{\oplus} \rfloor X+0=X$ $X \leftarrow I$
Number of digitpositions in integers in X

453 $\lfloor X+1 \leq 2 \rfloor X$ $X \leftarrow D$
Rounding to nearest even integer

454 $\lfloor X+.5 \times .5 \neq 2 \rfloor X$ $X \leftarrow D$
Rounding, to nearest even integer for .5 = 1 || X

455 $1+\lfloor 10^{\oplus} (X=0)+X \times 1 \rfloor 10[1+X<0]$ $X \leftarrow I$
Number of digit positions in integers in X

456 $1+\lfloor 10^{\oplus} X+0=X$ $X \leftarrow I$
Number of digits in positive integers in X

457 $X=\lfloor X$ $X \leftarrow D$
Test if integer

458 $(X,G)[(1+pX) \lfloor Y]$ $X \leftarrow A1; Y \leftarrow I; G \leftarrow A0$
Limiting indices and giving a default value G

459 $\lfloor X+1000$ $X \leftarrow I$
First part of numeric code ABBB

460 $(10*-X) \times \lfloor 0.5+Y \times 10*X$ $X \leftarrow I; Y \leftarrow D$
Rounding to X decimals

461 $0.01 \times \lfloor 0.5+100 \times X$ $X \leftarrow D$
Rounding to nearest hundredth

462 $\lfloor 0.5+X$ $X \leftarrow D$
Rounding to nearest integer

 MAGNITUDE / RESIDUE |

463 $(0=400|X) \vee (0 \neq 100|X) \wedge 0=4|X$ $X \leftarrow I$
Test if X is a leap year

464 $'_',[1]('|',X,'|'),[1]'-'$ $X \leftarrow C2$
Framing

465 $1||X$ $X \leftarrow D$
Magnitude of fractional part

466 $(0 \neq Y \mid \square pX)/X$ $X \leftarrow A1; Y \leftarrow I0$
Removing every Y:th element of X

467	$(0=Y\lfloor pX\rceil)/X$	$X\leftarrow A1; Y\leftarrow I0$
	<i>Taking every Y:th element of X</i>	
468	$(0=A\lfloor X\rceil)/A\leftarrow \lfloor X$	$X\leftarrow I0$
	<i>Divisors of X</i>	
469	$(2\lfloor pX\rceil)/X$	$X\leftarrow A1$
	<i>Removing every second element of X</i>	
470	$(0=Y\lfloor X\rceil)/X$	$X\leftarrow D1; Y\leftarrow D0 \text{ or } D1$
	<i>Elements of X divisible by Y</i>	
471	$\square I0+(pX)\lfloor Y+(Y\Phi X)\rfloor G$	$X\leftarrow A1; Y\leftarrow I0; G\leftarrow A$
	<i>Index of first occurrence of G in X (circularly) after Y</i>	
472	$(1+pY)\lfloor Y\lfloor X$	$Y\leftarrow A1; X\leftarrow A$
	<i>Changing index of an unfound element to zero</i>	
473	$\sim 2\lfloor X$	$X\leftarrow I$
	<i>Test if even</i>	
474	$X\lfloor Y\leq\lfloor X$	$X\leftarrow D; Y\leftarrow D$
	<i>Rounding to zero values of X close to zero</i>	
475	$(\times X)\times Y+\lfloor X$	$X\leftarrow D; Y\leftarrow D$
	<i>Increasing absolute value without change of sign</i>	
476	$(\times X)\lfloor X$	$X\leftarrow D$
	<i>Fractional part with sign</i>	
477	$X\lfloor \lfloor X$	$X\leftarrow D$
	<i>Square of elements of X without change of sign</i>	
478	$1\lfloor X$	$X\leftarrow D$
	<i>Fractional part</i>	
479	$1000\lfloor X$	$X\leftarrow I$
	<i>Last part of numeric code ABBB</i>	
---	<i>EXPAND \</i>	
480	$A\backslash(A\leftarrow\sim X\epsilon Y)\lfloor X$	$X\leftarrow A0; Y\leftarrow A1$
	<i>Replacing elements of X in set Y by blanks / zeroes</i>	
481	$A\backslash(A\leftarrow X\epsilon Y)\lfloor X$	$X\leftarrow A1; Y\leftarrow A$
	<i>Replacing elements of X not in set Y by blanks / zeroes</i>	
482	$A \Delta A[(\sim G)\lfloor pG]\leftarrow Y \Delta A\leftarrow G\backslash X$	$X\leftarrow A1; Y\leftarrow A1; G\leftarrow B1$
	<i>Merging X and Y under control of G (mesh)</i>	
483	$Y\backslash Y\lfloor X$	$X\leftarrow A; Y\leftarrow B1$
	<i>Replacing elements of X not fulfilling Y by blanks / zeroes</i>	

484	$\Phi\alpha\backslash\Phi X$	$X \leftarrow A$
	Scan from end with α	
485	$(\sim(\iota(\rho Y)+1\text{pp}X)\epsilon Y+\iota\rho Y)\backslash X$	$X \leftarrow A2; Y \leftarrow I1$
	Adding an empty row into X after rows Y	
486	$0\epsilon 0\backslash 0\rho X$	$X \leftarrow A1$
	Test if numeric	
487	$((Y+1)\neq 1+1\text{pp}X)\backslash X$	$X \leftarrow A2; Y \leftarrow I0$
	Adding an empty row into X after row Y	
488	$X,[\square I0-.1](' ' \neq X)\backslash '-'$	$X \leftarrow C1$
	Underlining words	
489	$(\rho Y)\rho(,Y)\backslash X$	$X \leftarrow A1; Y \leftarrow B2$
	Using boolean matrix Y in expanding X	
490	$((2\times\rho X)\rho 1\ 0)\backslash X$	$X \leftarrow C1$
	Spacing out text	
---	COMPRESS /	
491	$(X/Y)\geq A/1\Phi A\leftarrow(Y\vee X)/X$	$X \leftarrow B1; Y \leftarrow B1$
	Or-reduction ($\vee/$) of subvectors of Y indicated by X	
492	$(X/Y)\wedge A/1\Phi A\leftarrow(Y\leq X)/X$	$X \leftarrow B1; Y \leftarrow B1$
	And-reduction ($\wedge/$) of subvectors of Y indicated by X	
493	$(G/X),(\sim G)/Y$	$X \leftarrow C1; Y \leftarrow C1; G \leftarrow B0$
	Choosing a string according to boolean value G	
494	$(Av1\Phi A\leftarrow X\neq ' ')/X$	$X \leftarrow C1$
	(Cyclic) compression of successive blanks	
495	$(X\epsilon Y)/\iota\rho X$	$X \leftarrow A1; Y \leftarrow A$
	Indices of all occurrences of elements of Y in X	
496	$(\sim X\epsilon ' .,:;?''')/X$	$X \leftarrow A1$
	Removing punctuation characters	
497	$Y,(\sim X\epsilon Y)/X$	$X \leftarrow A1; Y \leftarrow A1$
	Union of sets, \cup	
498	$(\sim X\epsilon Y)/X$	$X \leftarrow A1; Y \leftarrow A$
	Elements of X not in Y (difference of sets)	
499	$(X[;1]\epsilon Y)\neq X$	$X \leftarrow A2; Y \leftarrow A1$
	Rows of non-empty matrix X starting with a character in Y	
500	$(X\epsilon Y)/X$	$X \leftarrow A1; Y \leftarrow A$
	Intersection of sets, \cap	

501	$((X_1 X)=1 \rho X)/X$	$X \leftarrow A1$
	<i>Removing duplicate elements (nub)</i>	
502	$((\rho X)*Y \neq 1 \rho \rho X) \rho \alpha/[Y]X$	$Y \leftarrow I0; X \leftarrow A$
	<i>Reduction in dimension Y, rank unchanged</i>	
503	$(Y=X)/1 \rho X$	$X \leftarrow A1; Y \leftarrow A0$
	<i>Indices of all occurrences of Y in X</i>	
504	$Y[X/1 \rho Y] \leftarrow G$	$Y \leftarrow A1 X \leftarrow B1 G \leftarrow A0$
	<i>Replacing elements of Y satisfying X with G</i>	
505	$A/19999 \Delta A[X] \leftarrow 1 \Delta A \leftarrow 9999 \rho 0$	$X \leftarrow I1$
	<i>Removing duplicates from positive integers</i>	
506	$X/1 \rho X$	$X \leftarrow B1$
	<i>Indices of ones in logical vector X</i>	
507	$(,X,[1.5]1)/,X,[1.5]~X$	$X \leftarrow B1$
	<i>Vector to expand a new element after each one in X</i>	
508	$((\sim X) / 'IN'), 'CORRECT'$	$X \leftarrow B0$
	<i>Conditional in text</i>	
509	$(X \neq Y)/X$	$X \leftarrow A1; Y \leftarrow A0$
	<i>Removing elements Y from vector X</i>	
510	$(' ' \# X)/X$	$X \leftarrow A1$
	<i>Removing blanks</i>	
511	$\alpha/,X$	$X \leftarrow D$
	<i>Reduction with α without respect to shape</i>	
512	Y/X	$X \leftarrow A; Y \leftarrow B1$
	<i>Selecting elements of X satisfying condition Y</i>	
513	$0 \# X$	$X \leftarrow A2$
	<i>Empty matrix</i>	
---	TRANSPOSE \otimes	
514	$\otimes F \otimes X$	$X \leftarrow A1; Y \leftarrow I0$
	<i>Applying to columns function F defined on rows</i>	
515	$((\Phi A) \times 1, Y) \rho 2 1 3 \otimes (1 \otimes Y, A + (\rho X) \div 1, Y) \rho X$	$X \leftarrow A2; G \leftarrow I0$
	<i>"Transpose" of matrix X with column fields of width Y</i>	
516	$X \times \otimes (\Phi \rho X) \rho Y$	$X \leftarrow D2; Y \leftarrow D1$
	<i>Multiplication of each column of matrix X by vector Y</i>	
517	$\otimes (\Phi \rho Y) \rho X$	$X \leftarrow A1; Y \leftarrow A2$
	<i>Matrix with shape of Y and X as its columns</i>	

518	$(Y\Phi 1\ 2)\Phi X$ Transpose matrix X on condition Y	$X\leftarrow A2; Y\leftarrow B0$
519	$\sim 0\epsilon X = -\Phi X$ Test for antisymmetry of square matrix X	$X\leftarrow D2$
520	$\sim 0\epsilon X = \Phi X$ Test for symmetry of square matrix X	$X\leftarrow A2$
521	$\Phi(X, \rho Y)\rho Y$ Matrix with X columns Y	$X\leftarrow I0; Y\leftarrow D1$
522	$1\ 1\Phi X[Y[1;]; Y[2;]]$ Retrieving scattered elements Y from matrix X	$X\leftarrow A2; Y\leftarrow I2$
523	$X[Y]\Phi G$ Successive transposes of G (X after Y: $X\Phi Y\Phi G$)	$X\leftarrow I1; Y\leftarrow I1$
524	$40\ 120\rho 2\ 1\ 3\Phi 10\ 40\ 12\rho X$ Dividing a 400x12 character matrix into one page	$X\leftarrow C2$
525	$(1*\rho X)\Phi X$ Main diagonal of array X	$X\leftarrow A$
526	$1\ 1\Phi X$ Diagonal elements of matrix X	$X\leftarrow A2$
527	$1\ 3\ 2\Phi X$ Transpose of planes of a rank three array	$X\leftarrow A3$
---	REVERSE / ROTATE $\Phi\Theta$	
528	$((1\Phi X)\times^{-1}\Phi Y) - (-1\Phi X)\times 1\Phi Y$ Vector (cross) product of vectors	$X\leftarrow D; Y\leftarrow D$
529	$1\Phi(\iota\rho X)\epsilon Y$ Ending points for X in indices pointed by Y	$X\leftarrow A1; Y\leftarrow I1$
530	$(-1\ 1[2\times I0]+\rho X) - (\Phi X)\iota Y$ Index of last element of Y in X	$X\leftarrow A1; Y\leftarrow A0$
531	$(1+\rho X) - (\Phi X)\iota Y$ Index of last occurrence	$X\leftarrow A1; Y\leftarrow A$
532	$(\Phi X)\iota Y$ Index of last occurrence, counted from the rear	$X\leftarrow A1; Y\leftarrow A$
533	$,\Phi[\Box I0+Y](1,\rho X)\rho X$ Reverse vector X on condition Y	$X\leftarrow A1; Y\leftarrow B0$
534	$(\Phi 1,\rho X)\rho X$ Reshaping vector X into a one-column matrix	$X\leftarrow A1$

535	(Φ_1, \dots)	... \leftarrow EXPRESSION
	<i>Avoiding parentheses with help of reversal</i>	
536	$1\Phi X$	$X \leftarrow A$
	<i>Rightmost neighboring elements cyclically</i>	
537	$\neg 1\Phi X$	$X \leftarrow A$
	<i>Leftmost neighboring elements cyclically</i>	
---	MEMBER OF ϵ	
538	$\sim(\iota(\rho Y) + \rho X) \in Y + \iota \rho Y$	$X \leftarrow A_1; Y \leftarrow I_1$
	<i>Expansion vector with zero after indices Y</i>	
539	$(\sim(\iota Y) \in X)$	$X \leftarrow I; Y \leftarrow I_0$
	<i>Boolean vector of length Y with zeroes in locations X</i>	
540	$(\iota \rho X) \in Y$	$X \leftarrow A_1; Y \leftarrow I_1$
	<i>Starting points for X in indices pointed by Y</i>	
541	$(X \in Y) \times Y \in X$	$X \leftarrow A; Y \leftarrow A_1$
	<i>Changing index of an unfound element to zero (not effective)</i>	
542	$(Y \leftarrow \square) \in \iota X$	$X \leftarrow A$
	<i>Check for input in range 1..X</i>	
543	$(\iota Y) \in X$	$X \leftarrow I; Y \leftarrow I_0$
	<i>Boolean vector of length Y with ones in locations X</i>	
544	$\sim 0 \in X = Y$	$X \leftarrow A; Y \leftarrow A$
	<i>Test if arrays are identical</i>	
545	$Y \times \sim Y \in X$	$Y \leftarrow D; X \leftarrow D$
	<i>Zeroing elements of Y depending on their values</i>	
546	$\iota \in \rho, X$	$X \leftarrow A$
	<i>Test if single or scalar</i>	
547	$\iota \in \rho \rho X$	$X \leftarrow A$
	<i>Test if vector</i>	
548	$0 \in \rho X$	$X \leftarrow A$
	<i>Test if X is an empty array</i>	
---	INDEX GENERATOR / INDEX OF ι	
549	$(G_1 X) < G_1 Y$	$X \leftarrow A; Y \leftarrow A$
	<i>Alphabetical comparison with alphabets G</i>	
550	$X \iota \rho X$	$X \leftarrow I_1$
	<i>Inverting a permutation</i>	

551 $(Y \neq X)_{i1}$ $X \leftarrow A1; Y \leftarrow A1$
Index of first differing element in vectors X and Y

552 $(\square I0 + \rho Y) = Y_{i1} X$ $X \leftarrow A; Y \leftarrow A1$
Which elements of X are not in set Y (difference of sets)

553 $A \Delta A[X] \leftarrow A \Delta A \leftarrow \rho X$ $X \leftarrow I1$
Inverting a permutation

554 $G[Y_{i1} X;]$ $X \leftarrow D; Y \leftarrow D1; G \leftarrow G2$
Changing numeric code X into corresponding name in Y

555 $\iota \rho X$ $X \leftarrow A$
All axes of array X

556 $\iota \rho X$ $X \leftarrow A1$
All indices of vector X

557 $X + G \times (\iota Y) - \square I0$ $X \leftarrow D0; Y \leftarrow D0; G \leftarrow D0$
Arithmetic progression of Y numbers from X with step G

558 $(X - \square I0) + \iota 1 + Y - X$ $X \leftarrow I0; Y \leftarrow I0$
Consecutive integers from X to Y (arithmetic progression)

559 X_{i1} $X \leftarrow B1$
Index of first satisfied condition in X

560 $\iota 1$
Index origin ($\square I0$) as a vector

561 $\square A V_{i1} X$ $X \leftarrow A$
Converting characters into numeric codes

562 $X_{i1} Y$ $X \leftarrow A1; Y \leftarrow A$
Index of key Y in key vector X

563 $\iota 0$
Empty numeric vector

LOGICAL ~ v ^ * &

564 $(Y[1] < X) \wedge X < Y[2]$ $X \leftarrow D; Y \leftarrow D1$
Test if X is within range ($Y[1], Y[2]$)

565 $(Y[1] \leq X) \wedge (X \leq Y[2])$ $X \leftarrow D; Y \leftarrow D1; 2 = \rho Y$
Test if X is within range [$Y[1], Y[2]$]

566 $0 \wedge X$ $X \leftarrow B$
Zeroing all boolean values

567 $(X \times G) + Y \times \sim G$ $X \leftarrow D; Y \leftarrow D; G \leftarrow B$
Selection between X and Y depending on condition G

568 $(\sim \square I0) + X$ $X \leftarrow I$
Changing an index origin dependent result to be as $\square I0=1$

569 $Y * \sim X$ $Y \leftarrow D; X \leftarrow B$
Conditional change of elements of Y to one according to X

570 $X \leq Y$ $X \leftarrow B; Y \leftarrow B$
 X implies Y

571 $X > Y$ $X \leftarrow B; Y \leftarrow B$
 X but not Y

572 $(0 \neq X) * Y \div X + 0 = X$ $X \leftarrow D; Y \leftarrow D$
Avoiding division by zero error (gets value zero)

573 $X \neq Y$ $X \leftarrow B; Y \leftarrow B$
Exclusive or

574 $X + Y \times X = 0$ $X \leftarrow D; Y \leftarrow D$
Converting zeroes to Y

575 $Y = X$ $X \leftarrow I; Y \leftarrow I$
Kronecker delta of X and Y (element of identity matrix)

576 $,((\rho X), Y) \rho G, X$ $X \leftarrow A1; Y \leftarrow I0; G \leftarrow A0$
Catenating Y elements G before every element of X

577 $, X, ((\rho X), Y) \rho G$ $X \leftarrow A1; Y \leftarrow I0; G \leftarrow A$
Catenating Y elements G after every element of X

578 $, Y, [\square I0 + .5] X$ $X \leftarrow A1; Y \leftarrow A1$
Merging vectors X and Y alternately

579 $X, \square T C[2], Y$ $X \leftarrow A1; Y \leftarrow A1$
Separating variable length lines

580 $, X, [1.1] ' '$ $X \leftarrow C1$
Spacing out text

581 $, X, [1.1] Y$ $X \leftarrow A1; Y \leftarrow A0$
Inserting Y after each element of X

582 $(X, X) \rho 1, X \rho 0$ $X \leftarrow I0$
 $X \times X$ identity matrix

583 $X, [.5 + \rho \rho X] - X$ $X \leftarrow D$
Array and its negative ('plus minus')

584	$X \leftarrow (\rho X) \rho A$ Δ $A[G] \leftarrow Y$ Δ $A \leftarrow X$ Temporary ravel of X for indexing with G	$X \leftarrow A; Y \leftarrow A; G \leftarrow I$
585	$X \leftarrow A \rho X$ Δ $X[G] \leftarrow Y$ Δ $X \leftarrow X$ Δ $A \leftarrow \rho X$ Temporary ravel of X for indexing with G	$X \leftarrow A; Y \leftarrow A; G \leftarrow I$
586	$X, [\square I 0 \dots 1]'^-$ Underlining a string	$X \leftarrow C1$
587	$X[:,1]$ First column as a matrix	$X \leftarrow A2$
588	$X, [.1]Y$ Forming a two-row matrix	$X \leftarrow A1; Y \leftarrow A1$
589	$X, [1.1]Y$ Forming a two-column matrix	$X \leftarrow A1; Y \leftarrow A1$
590	$((((\rho \rho X) - \rho \rho Y) \rho 1), \rho Y) \rho Y$ Increasing rank of Y to rank of X	$X \leftarrow A; Y \leftarrow A$
591	$((0.5 \times \rho X), 2) \rho X$ Reshaping vector X into a two-column matrix	$X \leftarrow A1$
592	$(\rho X) \rho \dots, X$ Handling array X temporarily as a vector	$X \leftarrow A; \dots \leftarrow EXPRESSION$
593	$(Y, \rho X) \rho X$ Forming a Y -row matrix with all rows alike (X)	$X \leftarrow A1; Y \leftarrow I0$
594	$((\rho X), 1) \rho X$ Reshaping vector X into a one-column matrix	$X \leftarrow A1$
595	$(1, \rho X) \rho X$ Reshaping vector X into a one-row matrix	$X \leftarrow A1$
596	ρ, X Number of elements (also of a scalar)	$X \leftarrow A$
597	$Y, 0 \rho X$ Joining sentences	$X \leftarrow A; Y \leftarrow A1$
598	$X \leftarrow 0 2 1 2 5 8 0 4 5, \square$ Entering from terminal data exceeding input (printing) width	$X \leftarrow D$
---	AXIS / INDEXING [
599	$(\rho X)[\rho \rho X]$ Number of columns in array X	$X \leftarrow A$
600	$(\rho X)[2]$ Number of columns in matrix X	$X \leftarrow A2$

601	$(\rho X)[1]$	$X \leftarrow A2$
	Number of rows in matrix X	
602	$Y[2+\times X]$	$X \leftarrow D; Y \leftarrow A1$
	Choosing according to signum	
603	$Y \times 1 - 1[1+\times]$	$Y \leftarrow D; X \leftarrow B$
	Conditional elementwise change of sign	
604	$X[2 \times \square I0]$	$X \leftarrow A1$
	Selection depending on index origin	
605	$' *'[\square I0+\times]$	$X \leftarrow B$
	Indexing with boolean value X (plotting a curve)	
606	$X[\square I0+\times]$	$X \leftarrow A1; Y \leftarrow I$
	Indexing independent of index origin	
607	$X[;1]$	$X \leftarrow A2$
	First column as a vector	
608	$X[] \leftarrow 0$	$X \leftarrow D1$
	Zeroing a vector (without change of size)	
609	$X[1]$	$X \leftarrow A1$
	Selection depending on index origin	
---	$SHAPE / RESHAPE \rho$	
610	$(Y \times \rho X) \rho X$	$X \leftarrow A1; Y \leftarrow I0$
	Duplicating vector X Y times	
611	$X \times (\rho X) \rho Y$	$X \leftarrow D; Y \leftarrow D1$
	Multiplication of each row of X by vector Y	
612	$\rho \rho X$	$X \leftarrow A$
	Rank of array X	
613	$1 \rho \rho X$	$X \leftarrow A2$
	Number of rows in matrix X	
614	$(\rho Y) \rho X$	$X \leftarrow A1; Y \leftarrow A$
	Array with shape of Y and X as its rows	
615	$1 \rho X$	$X \leftarrow A$
	Corner element of a (non-empty) array	
616	$'' \rho X$	$X \leftarrow A$
	Reshaping X into a scalar	
617	$0 \rho X \leftarrow$	$X \leftarrow A$
	Output of an empty line	

618 0 80p0
Forming an initially empty array to be expanded

ARITHMETIC + - x +

619 1+÷2+÷3+÷4+÷5+÷6 ...
Continued fraction

620 Y×÷X $X \leftarrow D; Y \leftarrow D$
Force 0÷0 into DOMAIN ERROR in division

621 1 -1×X $X \leftarrow D$
Number and its negative ('plus minus')

622 Y×X $X \leftarrow D; Y \leftarrow B$
Selecting elements satisfying condition Y, zeroing others

623 X×-1×Y $X \leftarrow D; Y \leftarrow B; pX \leftrightarrow pY$
Conditional elementwise change of sign

624 0×X $X \leftarrow D$
Zero array of shape and size of X

625 -□IO-X $X \leftarrow I$
Changing an index origin dependent result to be as □IO=0

626 (□IO-1)+X $X \leftarrow I$
Changing an index origin dependent argument to act as □IO=1

627 +X← $X \leftarrow D$
Output of assigned numeric value

628 □IO+X $X \leftarrow I$
Changing an index origin dependent argument to act as □IO=0

MISCELLANEOUS

629 *
Syntax error to stop execution

630 □←X← $X \leftarrow A$
Output of assigned value

631 □LX←□
Setting latent expression

SYNONYM LIST

*Adding X to each column of Y*193 1 1 2QX..+Y
192 1 2 1QY..+X*Adding X to each row of Y*190 2 1 2QX..+Y
189 1 2 2QY..+X*Arithmetic average (mean value)*365 (+/X)÷ρX
332 (+/,X)÷1ρ,X*Ascending cardinal numbers (ranking)*1 L.5×(ΔΔX)+ΦΔΔΦX
13 ΔΔX*Centering text*323 Y↑((L-.5×Y,ρX)ρ''),X
393 (-L.5×Y+ρX)↑X
269 (-L0.5×+/^' '=ΦX)ΦX
248 (A-L0.5×(A↔+/^ΦA)++/^A↔' '=ΦX)ΦX*Changing index of an unfound element to zero*472 (1+ρY)|YiX
541 (XεY)×YiX*Conditional elementwise change of sign (see section on code to section)*603 Y×1 -1[1+X]
623 X×-1*Y*Diagonal elements of matrix X*526 1 1QX
525 (1*ρX)QX

Drop of Y first rows from matrix X

444 $(Y, 0) \downarrow X$
388 $(2 \uparrow Y) \downarrow X$

Evaluating a two-row determinant

314 $-/x/0 1\theta X$
313 $-/x/0 1\phi X$

Expansion vector with zero after indices Y

27 $(\rho X) \geq \Delta(\iota \rho X), Y$
538 $\sim(\iota(\rho Y) + \rho X) \in Y + \iota \rho Y$

First ones in groups of ones

381 $X > ((-\rho\rho X) \uparrow^{-1}) \downarrow 0, X$
440 $X >^{-1} \downarrow 0, X$

Giving a default value for input

97 $1\rho(\pm\Box, ', 10'), X$
403 $1\uparrow\Box, X$

Index of (first) maximum element of X

23 $-1\uparrow\Delta X$
330 $X \uparrow\Box/X$

Index of (first) minimum element of X

22 $1\uparrow\Delta X$
336 $X \downarrow\Box/X$

Indices of ones in logical vector X

41 $(+/X) \uparrow\Box X$
280 $(+\backslash X) \uparrow\Box +/X$
506 $X / \iota \rho X$

Inverting a permutation

37 ΔX
553 $A \Delta A[X] \leftarrow A \Delta A \leftarrow \iota \rho X$
550 $X \uparrow\Box \iota \rho X$

Locations of texts between and including quotes

287 $A^{-1} \downarrow 0, A \leftarrow 2 | + \backslash X = ' ' '$

Locations of texts between quotes

288 $A^{-1} \downarrow 0, A \leftarrow 2 | + \backslash X = ' ' '$

Merging (mesh)

482 $A \Delta A[(\sim G) / \wp G] \leftarrow Y \Delta A \leftarrow G \backslash X$
12 $(X, Y)[\Delta \Delta G]$
16 $(Y, X)[\Delta \nabla G]$
31 $A \Delta A[\Delta G] \leftarrow A \leftarrow Y, X$
11 $(Y, X, Z, \dots)[\Delta \Delta G]$

Number and its negative ('plus minus')

621 $1^{-1} \times X$
583 $X, [.5 + \wp \wp X] - X$
204 $X \cdot \cdot \times 1^{-1}$

Number of columns in matrix X

600 $(\wp X)[2]$
410 $-1 \uparrow \wp X$
445 $1 \downarrow \wp X$
599 $(\wp X)[\wp \wp X]$

Number of elements (also of a scalar)

366 $\times / \wp X$
596 \wp, X

Number of occurrences of scalar X in array Y

236 $X + . = , Y$
362 $+ / X = , Y$

Number of rows in matrix X

601 $(\wp X)[1]$
411 $1 \uparrow \wp X$

613 $1\phi\phi X$
 446 ${}^{-1}\downarrow\phi X$

Occurrence(s) of string X in string Y

178 $(\wedge\neq({}^{-1}\downarrow\phi X)\phi X\cdot.=Y)\downarrow 1$
 147 $(Y[A\cdot. +{}^{-1}\downarrow\phi X]\wedge.=X)/A\leftarrow(A=1\uparrow X)/\phi A\leftarrow(1-\phi X)\downarrow Y$
 219 $(({}^{-1}A)\downarrow X\wedge.=A,1+\phi Y)\phi Y)/\wedge(\phi Y)+1-A\leftarrow\phi X$

Output of assigned value

630 $\square\leftarrow X\leftarrow$
 627 $+X\leftarrow$

Removing duplicate elements

501 $((X\downarrow X)=\phi X)/X$
 154 $(1\ 1\phi<\backslash X\cdot.=X)/X$
 505 $A/\iota 9999\ \Delta\ A[X]\leftarrow 1\ \Delta\ A\leftarrow 9999\phi 0$
 422 $({}^{-1}\phi 1\downarrow(X\neq{}^{-1}\phi X),1)/X$

Removing duplicate rows

70 $((A\downarrow A)=\phi A\leftarrow 2\downarrow X\wedge.=\phi X)\neq X$
 208 $(1\ 1\phi<\backslash X\wedge.=\phi X)\neq X$
 327 $({}^{-1}\phi 1\downarrow(\vee/X\neq{}^{-1}\phi X),1)\neq X$
 206 $((A\downarrow A)=\phi A\leftarrow\square 10++\neq\wedge\downarrow X\vee.=\phi X)\neq X$

Removing leading blanks

267 $(+/^\backslash' '=X)\downarrow X$
 299 $(\vee\backslash' ' \neq X)/X$

Removing trailing blanks

298 $(\phi\vee\phi' ' \neq X)/X$
 73 $(1-(' ' = X)\downarrow 1)\downarrow X$
 397 $({}^{-1}\uparrow(' ' \neq X)/\phi X)\phi X$
 428 $(1-(\phi' ' \neq X)\downarrow 1)\downarrow X$
 266 $(-+/^\backslash' ' =\phi X)\downarrow X$

Removing trailing blank columns

272 $(\phi\vee\phi\vee\neq ' ' \neq X)/X$
 209 $(\phi\vee\phi' ' \vee. \neq X)/X$

Replicate Y[i] X[i] times (for all i)

```
250  Y[+\\(i+/X)ε-1↓1++\\0,X]
251  ((X≠0)/Y)[+\\-1Φ(i+/X)ε+\\X]
253  Y[□IO++\\(i+/X)ε□IO++\\X]
```

Representations of current date

```
107  A Δ A[(' '=A)/\\pA]↔'/' Δ A↔\\100|1Φ3↑□TS
65   A Δ A[5 8]↔'-' Δ A↔\\1000↓3↑□TS
104  A Δ A[(' '=A)/\\pA]↔'..' Δ A↔Φ3↑□TS
72   100↓100|3↑□TS
```

Representations of current time

```
64   A Δ A[3 6]↔':.' Δ A↔\\1000↓3↑3↓□TS
105  (,(0 1↓3 0\\100+3 1\\12 0 0|3↑3↓□TS),':.'),'AP'[1+12≤□TS[4]],'M'
```

Reshaping non-empty lower-rank array X into a matrix

```
392  (1↑-2↑\\pX)\\pX
402  (-2↑1 1,\\pX)\\pX
```

Reshaping vector X into a one-column matrix

```
203  X◦.+,0
534  (Φ1,\\pX)\\pX
594  ((\\pX),1)\\pX
```

Selection depending on index origin

```
604  X[2×□IO]
609  X[1]
```

Sorting rows of matrix X into ascending order

```
9  (\\pX)\\p(,X)[A[Δ(,Φ(Φ\\pX)\\p↓1↑\\pX)[A↔Δ,X]]]
8  (\\pX)\\p(,X)[□IO+A[Δ|A÷-1↑\\pX]] Δ A↔(Δ,X)-□IO
```

Spacing out text

```
580  ,X,[1.1] ' '
490  ((2×\\pX)\\p↓0)\\X
```

Temporary ravel of X for indexing with G

585 $X \leftarrow A \rho X \Delta X[G] \leftarrow Y \Delta X \leftarrow, X \Delta A + \rho X$
584 $X \leftarrow (\rho X) \rho A \Delta A[G] \leftarrow Y \Delta A \leftarrow, X$

Test for symmetricity of matrix X

86 $\pm \pm '1', '1\downarrow' [\square I O + \wedge / (\rho X) = \Phi \rho X], '0\sim 0 \in X = \Phi X'$
520 $\sim 0 \in X = \Phi X$

Test if all elements of vector X are equal

358 $\wedge / X = X[1]$
343 $\wedge / X = 1 \Phi X$
340 $0 = (\rho X) \mid + / X$
159 $v / \wedge / 0 \ 1 \circ . = X$
324 $\wedge / X = 1 \uparrow X$
315 $(\wedge / X) v \sim v / X$
311 $(\Gamma / X) = l / X$
317 $\wedge / X \div v / X$
352 $\neq / 0 \ 1 \in X$
316 $(\wedge / X) = v / X$
347 $\wedge / 0 \ 1 \in X$
215 $X \wedge . = \wedge / X$
214 $X \wedge . = v / X$
341 $\wedge / X / 1 \Phi X$
354 $\wedge / \square I O = X \downarrow X$
349 $\sim \wedge / X \in \sim X$

Test if arrays of equal shape are identical

357 $\wedge / , X = Y$
544 $\sim 0 \in X = Y$

Test if numeric

400 $0 \in 1 \uparrow 0 \rho X$
486 $0 \in 0 \downarrow 0 \rho X$

Test if X is a permutation vector

20 $X[\Delta X] \wedge . = \downarrow \rho X$
158 $\wedge / 1 = + / X \circ . = \downarrow \rho X$
346 $\wedge / (\downarrow \rho X) \in X$

Value of polynomial with coefficients Y at point X

227 $(X * \downarrow + \downarrow \rho Y) + . \times \Phi Y$
83 $X \downarrow Y$
69 $(X \circ . + , 0) \downarrow Y$

Value of Taylor series with coefficients Y at point X

137 $+/Y \times (X \times A) \div !A \div !1 + pY$
281 $+/Y \times \times \backslash 1, X \div !1 + pY$

Vectors as matrices in catenation

273 $X, [\square I0 - (*\backslash 2p^2/2 > (ppX), ppY) / .5 0] Y$
274 $X, [\square I0 + (*\backslash 2p^2/2 > (ppX), ppY) / .5 1] Y$

 $X \times X$ identity matrix

197 $(iX) \cdot \cdot = iX$
582 $(X, X) p1, X p0$

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Executing costly monadic function F on repetitive

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